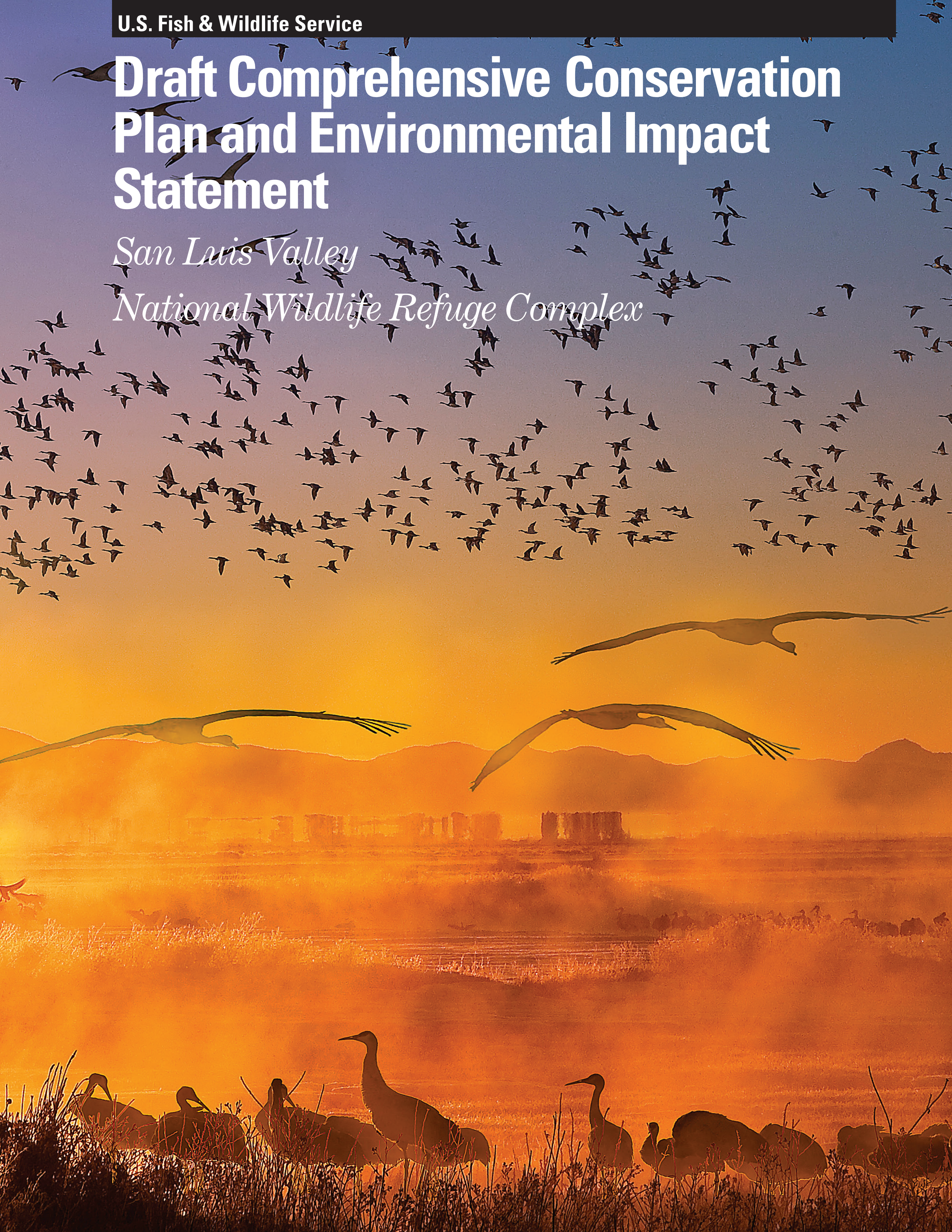
U.S. Fish & Wildlife Service

Draft Comprehensive Conservation Plan and Environmental Impact Statement

San Luis Valley

National Wildlife Refuge Complex



The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.

The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

Comprehensive conservation plans provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the U.S. Fish and Wildlife Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

Cover photograph of sandhill cranes and other birds at San Luis Valley National Wildlife Refuge Complex.

Draft Comprehensive Conservation Plan and Environmental Impact Statement

San Luis Valley National Wildlife Refuge Complex

Colorado

August 2014

Prepared by

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CITATION

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Abstract

Draft Comprehensive Conservation Plan and Environmental Impact Statement

San Luis Valley National Wildlife Refuge Complex: Alamosa, Monte Vista, and Baca National Wildlife Refuges, Colorado

Type of Action: Administrative
Lead Agency: U.S. Fish and Wildlife Service
Responsible Official: Noreen Walsh, Director, Region 6, U.S. Fish and Wildlife Service

This *Draft Comprehensive Conservation Plan* and Environmental Impact Statement identifies the purpose and need for a management plan, outlines the legal foundation for management of the San Luis Valley National Wildlife Refuge Complex (refuge complex), and describes and evaluates four alternative plans for managing wildlife, habitat, and wildlife-dependent public use. This process has involved the development of a vision, goals, objectives, and strategies that meet the legal directives of the U.S. Fish and Wildlife Service (Service) and considered stakeholder input.

Under alternative A, No-Action, we would make few changes in how we manage the various habitats and wildlife populations throughout the refuge complex. Generally, we would continue to manage habitats on the Alamosa and Monte Vista Refuges through the manipulation of water, as described in the 2003 CCP (FWS 2003) or under the guidance found in the conceptual management plan for the Baca Refuge. All the refuges would adhere to new State regulations regarding water use. There would be few additional public uses outside of what already occurs on the Monte Vista and Alamosa refuges. The Baca Refuge would remain closed to public use except for access to a refuge office or contact station. We would continue to maintain our existing partnerships in and around the refuge complex. Future land protection efforts would be restricted to the acquisition of private inholdings within existing refuge boundaries, conservation easements identified in the Sangre de Cristo Conservation Area, or easements or acquisitions identified in the San Luis Valley Conservation Area.

Under alternative B, Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (draft proposed action), we would approach management with an emphasis on maintaining or restoring the composition, structure, and function of natural and modified habitats. We would take into greater consideration the ecological site characteristics and wildlife species requirements on our refuge lands by developing sound and sustainable management strategies that maintain and/or restore the ecological integrity, productivity, and biological diversity. We would apply strategic habitat conservation principles (a structured, science-driven, and adaptive approach) in determining where and how to best benefit native fish, wildlife, and plant species, emphasizing migratory birds, waterfowl, and declining or listed species. Compatible wildlife-dependent public uses and access would be enhanced and expanded to include all three refuges. We would facilitate the protection, restoration, and conservation of important water resources through partnerships, public education, and our stewardship.

Under alternative C, Habitat Restoration and Ecological Processes, we would take all feasible actions to restore or mimic, where needed, the native vegetative community based on ecological site characteristics and other abiotic factors as well as ecological processes (such as hydrologic conditions and other natural disturbances such as grazing and fire). We would continue to maintain compatible wildlife-dependent public uses, but they could be adapted in response to changes in area management. Our partnership efforts would be broadened and geared toward restoring native vegetative communities and historic hydrologic conditions.

Under alternative D, Maximize Public Use, we would manage existing wildlife and their habitats consistent with our mission and purposes of the refuges while emphasizing quality visitor experiences and compatible wildlife-dependent public uses. Partnerships that complement our efforts to accommodate and provide for the priority public uses would be strengthened.

Commenting

Comments should be mailed to the U.S. Fish and Wildlife Service, attn: Laurie Shannon, Planning Team Leader, Division of Refuge Planning, P.O. 25486, Denver, CO 80225 or delivered to: 134 Union Blvd., Lakewood, CO 80028. Comments are due 60 days after the notice of availability is published in the Federal Register. Comments may be sent by email to: <slvrefugesplanning@fws.gov>. All comments received from the public and other stakeholders will be placed in the agency's record for this planning process. Comments will be made available for inspection by the general public, and copies may also be provided to the public. For further information contact Laurie Shannon at (303) 236-4317.

Cooperating Agencies

Bureau of Land Management, Bureau of Reclamation, USDA Forest Service, National Park Service, Natural Resources Conservation Service, Colorado Parks and Wildlife, and Colorado Division of Water Resources.

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Summary

A herd of bull elk on Baca National Wildlife Refuge.

We, the U.S. Fish and Wildlife Service, have developed a draft comprehensive conservation plan and environmental impact statement (draft CCP and EIS) to describe alternatives and identify potential consequences for the management and use of the San Luis Valley National Wildlife Refuge Complex (refuge complex, the refuges) in Colorado. The alternatives are the result of extensive public input and working closely with several cooperating agencies: Bureau of Land Management, National Park Service, Natural Resources Conservation Service, Bureau of Reclamation, Colorado Parks and Wildlife, and Colorado Division of Water Resources. Other governmental agencies, tribal agencies, nongovernmental organizations, businesses, and private citizens contributed substantial input to the plan.

The refuge complex includes Monte Vista, Alamosa, and Baca National Wildlife Refuges, and it covers parts of Rio Grande, Alamosa, Costilla, and Saguache counties within the San Luis Valley in Colorado. The San Luis Valley is about 80 miles long, and runs from Poncha Pass to the north and south into New Mexico. It is about 50 miles wide at its widest point. The foothills of the San Juan Mountains lie directly west of the Monte Vista National Wildlife Refuge, immediately south of where the Rio Grande enters the San Luis Valley. Across the valley, the linear Sangre de Cristo Range rises sharply from the eastern boundary of the Baca National Wildlife Refuge, reaching heights of over 14,000 feet.

Wildlife habitat within the three refuges includes diverse wetlands, riparian areas, playas, grasslands, and shrublands that provide important resources for many migratory birds, elk, deer, and a variety of other wildlife. About 18,000 to 20,000 greater sandhill cranes migrate through the valley every spring and fall, where they spend several weeks resting and foraging for food on and around the Monte Vista National Wildlife Refuge. The federally endangered southwestern willow flycatcher breeds along the Rio Grande on the Alamosa National Wildlife Refuge. Baca National Wildlife Refuge has one of two aboriginal (natural) populations of Rio Grande suckers found in the State, which were proposed for listing under the Endangered Species Act in 2013.

Visitors take part in a variety of wildlife-dependent recreational activities on the refuge complex. Every year, the Monte Vista Crane Festival attracts thousands of visitors who come to see sandhill cranes and waterfowl. The Monte Vista and Alamosa National Wildlife Refuges are also open for waterfowl hunting and wildlife observation. This CCP and EIS would consider opening the Baca National Wildlife Refuge for hunting, wildlife observation, photography, interpretation, and environmental education.

Over 12,000 years of prehistory and history have been recorded in the San Luis Valley, and all three national wildlife refuges contain significant cultural resources.

We could not accomplish our conservation mission without the many partner organizations who we work with in the valley, including the Friends of the San Luis Valley National Wildlife Refuges; The Nature Conservancy; local land trusts; schools; Federal, State and local governmental agencies; Native American tribes; and interested citizens.

The San Luis Valley National Wildlife Refuge Complex

The Monte Vista National Wildlife Refuge was established in 1952 as the first national wildlife refuge in Colorado, and its approved acreage is about 14,834 acres. The Alamosa National Wildlife Refuge was established in 1962, and its approved acreage is about 10,291 acres. Both refuges were established under the authority of the 1929 Migratory Bird Conservation Act (45 Stat. 122; 16 U.S.C.§715d) "…for use as inviolate sanctuaries, or for any other management purposes, for migratory birds."

The Baca National Wildlife Refuge was authorized by Public Law 106-530 on November 22, 2000, as part of the Great Sand Dunes National Park and Preserve Act of 2000, and its authorized boundary is about 92,500 acres. It was established in 2003 with the acquisition of the first parcel. The purpose of the refuge is to "restore, enhance, and maintain wetland, upland, riparian, and other habitats for native wildlife, plant, and fish species in the San Luis Valley." Additionally, in administering the refuge, we are to "(A) emphasize migratory bird conservation; and (B) take into consideration the role of the Refuge in the broader landscape conservation efforts; and (C) [subject to any agreement in existence as of the date of enactment of this paragraph, and to the extent consistent with purposes of the refuge] "use decreed water rights on the refuge in approximately the same manner that the water rights have been used historically."

PURPOSE AND NEED FOR THE PLAN

The purpose of this draft CCP and EIS is twofold: to describe the role of each refuge in the complex in supporting the mission of the National Wildlife Refuge System, and to provide long-term guidance for the management of refuge programs and activities. The CCP is needed to help us achieve the following:

- communicate with the public and other partners about our efforts to carry out the mission of the Refuge System and meet the purposes of the refuges;
- provide a clear statement of direction for management of the refuge complex;
- ensure that the refuges within the refuge complex continue to conserve fish, wildlife, and ecosystems in the face of ongoing drought, water shortages, and climate change;
- provide neighbors, visitors, and government officials with an understanding of our management actions on and around the refuge complex;
- ensure that our management actions are consistent with the mandates of the National Wildlife Refuge System Improvement Act of 1997;
- ensure that management of the refuge complex considers other Federal, State, and local government plans;
- provide a basis for development of budget requests for the operation, maintenance, and capital improvement needs of the refuge complex.

We are committed to sustaining the Nation's fish and wildlife resources through the combined efforts of governments, businesses, and private citizens.

National Wildlife Refuge System

Like all national wildlife refuges, the refuge complex is administered under the National Wildlife Refuge System Administration Act of 1996 as amended in 1997.

The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

Public Involvement

In March 2011, we began our public scoping for this project with the release of a public involvement summary and a planning update that described the CCP process and its anticipated schedule. We published a notice of intent to prepare a CCP in the Federal Register on March 15, 2011 (76 FR Doc. 2011-5924). Since then, we conducted six public meetings during the scoping and development of the alternatives; mailed two planning updates; posted information on our Web page for the CCP; and coordinated with Federal, State, and local agencies and Native American tribes.

Significant Issues

The scoping process identified many qualities of the refuge complex along with issues and recommendations. Based on this information as well as guidance from the National Wildlife Refuge System Improvement Act of 1997, National Environmental Policy Act, and planning policy, we identified seven significant issues to address:

- Habitat and wildlife management
- Water resources
- Landscape conservation and wilderness review
- Visitor services
- Partnerships and operations
- Cultural resources and tribal coordination
- Research, science, and protection of the physical environment

Habitat and Wildlife

The draft CCP and EIS addresses the following habitat and wildlife issues:

- The future management of a wide variety of habitats on the three national wildlife refuges including wet meadows, playa wetlands, riparian areas, desert shrublands and grasslands, and croplands. Some of these habitats may not be sustainable without a continued emphasis on water management.

- Whether we should continue to provide barley, which is a nonnative crop that provides sandhill cranes and waterfowl with a high-carbohydrate food source in a small area, but which also removes that land and associated water from the production of native vegetation.

- The issues associated with increasing elk populations across the refuges. On both the Baca and Alamosa National Wildlife Refuges, elk are having a significant effect on some resources, particularly riparian areas.

- On the Alamosa National Wildlife Refuge, we have seen that impacts to the hydrology of the refuge have affected the federally endangered southwestern willow flycatcher.

- There has been interest expressed in the reintroduction of the American bison on the Baca National Wildlife Refuge. Whether the refuge could support free-roaming bison without negatively affecting other species is an issue of concern.

- Other issues include the use of prescribed fire, livestock grazing, haying, farming, control of invasive species, wildland fire suppression, and management of diseases.

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Large colonial birds, sandhill cranes find rest and food during their long migration.

Water Resources

The topic of water is one of the biggest concerns for the refuge complex. The draft CCP and EIS addresses the following concerns:

- Amount and timing of water use
- Water quality

- Pumping from wells and use of irrigation across the refuge complex
- The management and protection of wetlands including playas, riparian areas, and the river corridor

Landscape Conservation and Wilderness Review

We work closely with many individuals, organizations, and agencies in protecting wetlands and other areas in the San Luis Valley. The draft CCP and EIS addresses whether any areas within the refuge complex meet the values expressed in the Wilderness Act of 1964 and the Service's Wilderness Stewardship Plan.

Visitor Services

Types of visitor opportunities and access considerations include:

- Opening the Baca National Wildlife Refuge for public uses including hunting and nonconsumptive uses
- Expanding the hunting program to include elk hunting
- Providing opportunities for interpretation and environmental education
- Allowing biking, walking, cross-country skiing, or horseback use to facilitate wildlife-dependent recreation
- Providing opportunities for fishing access along the Rio Grande on the Alamosa National Wildlife Refuge.

PARTNERSHIPS AND REFUGE OPERATIONS

Many agencies, organizations, and landowners are working in partnership with us to accomplish many of our common goals. How we manage the refuges, particularly our operational and infrastructure needs, are being considered.

Cultural Resources and Tribal Coordination

Only about 5 percent of the refuge complex has been comprehensively inventoried for cultural resources. We are concerned that the lack of information could lead to destruction of important sites. Lack of research, concerns about vandalism, lack of staff to maintain our legal obligations, and ongoing relations with tribes, collectors, and other agencies are important issues to be addressed.

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Researchers and volunteers examine a cultural resource site on Monte Vista National Wildlife Refuge. There are 12,000 years of history and prehistory in the San Luis Valley.

Research, Science, and Protection of the Physical Environment

The refuge complex is surrounded by large, contiguous tracts of open land. There are many opportunities to work with others to achieve our research and science needs. Baca National Wildlife Refuge is adjacent to designated and proposed wilderness and a class 1 air quality area. Other physical attributes include the immense dark night sky and quiet soundscapes. These were identified as important qualities for many residents in the surrounding community. Climate change is one of our biggest issues affecting plants and wildlife across our lands. Strategies for managing the refuges in light of climate change, a declining aquifer, energy development, wildlife diseases, and invasive species are important issues to address.

Vision

We developed a vision for the refuge complex at the beginning of the planning process. The vision describes the focus of refuge complex management and portrays a picture of the refuge complex in 15 years.

Goals

We developed six goals for the draft comprehensive conservation plan.

Habitat and Wildlife Goal

Conserve, restore, and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.

Water Resources Goal

As climate patterns change, protect, acquire, and manage surface and ground water resources to maintain and support management objectives.

Visitor Services Goal

Provide safe, accessible, and quality wildlife-dependent recreation and perform outreach to visitors and local communities to nurture an appreciation and understanding of the unique natural and cultural resources of the refuge complex and San Luis Valley.

Partnerships and Refuge Complex Operations Goal

Secure and effectively use funding, staffing, and partnerships for the benefit of all resources in support of the refuge complex purposes and the mission of the National Wildlife Refuge System.

Actively pursue and continue to foster partnerships with other agencies, organizations, the water community, and private landowners to conserve, manage, and provide for the long-term sustainability of working landscapes within the San Luis Valley.

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Western chorus frogs provide an important food source for migratory birds.

Cultural Resources Goal

Protect significant cultural resources within the San Luis Valley National Wildlife Refuge Complex.

Research, Science, and Wilderness Review Goal

Use sound science, applied research, monitoring, and evaluation to advance the understanding of natural resource functions, changing climate conditions, and wilderness values in the management of the habitats within the San Luis Valley ecosystem.

Alternatives

Following the scoping process in 2011, we carried forward the following four alternatives and analyzed them in detail in this draft CCP and EIS.

Alternative A (No Action)

Under the no-action alternative, we would make few changes in how we manage the various habitats and wildlife populations throughout the refuge complex. We would continue to manage habitats on the Monte Vista and Alamosa National Wildlife Refuges through the manipulation of water as described in the 2003 CCP (FWS 2003). Water management on the Baca National Wildlife Refuge would continue under the guidance found in the conceptual management plan for the Baca National Wildlife Refuge. All the refuges would adhere to new State regulations regarding water use. There would be few added public uses outside of those that already occur on the Monte Vista and Alamosa National Wildlife Refuges. The Baca National Wildlife Refuge would remain closed to public use except for potential access to a refuge office or contact station. We would continue to collaborate with our partner agencies and organizations to achieve our conservation goals.

Habitat and Wildlife Resources

On all three refuges, we would continue to manage wetland areas and wet meadows to provide habitat for a variety of waterbirds. Riparian and upland habitats would be managed for migratory birds. We would continue to produce small grains at current levels on the Monte Vista National Wildlife Refuge (up to 270 acres, depending on water availability and crop rotation) to provide food for spring-migrating sandhill cranes.

There would be few changes made in managing big game populations on the refuge complex. Elk numbers would continue to fluctuate from 1,000 to 4,000 individuals on the Baca National Wildlife Refuge and smaller herds on the Monte Vista and Alamosa National Wildlife Refuges. Population distribution and control would be limited to nonlethal dispersal, agency culling, and the public dispersal hunts (also called distribution hunts) on the former State lands of the Baca National Wildlife Refuge.

We would continue to protect populations of, and manage habitats for, threatened and endangered species as well as for species of concern. These species include southwestern willow flycatcher, Rio Grande sucker, Rio Grande chub, and northern leopard frog.

We would phase out the existing arrangement with The Nature Conservancy for season-long bison use on those parts of the Medano Ranch that are within the Baca National Wildlife Refuge boundary, and we would not use bison as a management tool in the future.

We would continue to use prescriptive livestock grazing, haying, and cooperative farming as management tools for maintaining habitats within the refuge complex. We would continue to control invasive and noxious weeds. Similarly, we would continue to follow fire funding guidelines in the prioritization of fuels treatments and use of fuels funding. We would pursue alternative funding sources for prescribed fire implementation.

Water Resources

We would keep our ability to use our water rights within the refuge complex. The use of ground water would continue, except as modified by changing State rules, regulations, and policies. We will augment water supplies in accordance with State law.

Visitor Services

Compatible wildlife-dependent public uses, including waterfowl and small game hunting, would continue to be allowed on the Monte Vista and Alamosa National Wildlife Refuges, but we would not seek to establish elk hunting on any of the refuges other than the authorized distribution hunts on the Baca National Wildlife Refuge.

The auto tour routes and the existing nature and walking trails on the Alamosa and Monte Vista National Wildlife Refuges would continue to provide some wildlife observation, interpretation, and photographic opportunities. We would open the visitor center on the Alamosa National Wildlife Refuge on a part-time basis as volunteer resources allow. Our primary environmental education events, such as the Monte Vista Crane Festival, the Kids Crane Festival in the fall, Kid's Fishing Day, would continue.

Public access via trails or a tour route would not be established on the Baca National Wildlife Refuge, and the refuge would remain closed to the public except for occasional staff-led tours and access to an office or visitor contact station. A refuge office with a visitor contact station was recently approved for construction at the Baca National Wildlife Refuge, and a few interpretive kiosks or other facilities would be installed.

Cultural Resources

Under Section 106 of the National Historic Preservation Act, we would continue to conduct cultural resource reviews for projects that disturb the ground or affect buildings or structures over 50 years of age. We would avoid disturbing significant cultural resources unless disturbance is required by unusual circumstances. In addition we would continue to conduct law enforcement patrols and monitor sensitive sites. As required, we would consult with the Colorado State Historic Preservation Office and Native American tribes and adhere to cultural resource laws.

Partnerships and Refuge Complex Operations

We would continue to work with a variety of other agencies and non-profit organizations, including the Friends of the San Luis Valley National Wildlife Refuges, to achieve our goals for habitat and wildlife management. Refuge complex operations would continue within existing funding levels. As such, there would be few new financial resources available to increase programs or services. We would continue to coordinate and work with adjacent landowners to reduce potential conflicts.

In accordance with the provisions of the interim elk management plan, we would work with Colorado Parks and Wildlife to coordinate dispersal hunts, hazing, and lethal removal of elk by agency staff to reduce damage to the lands next to the refuges and riparian habitats on the refuges.

The use of haying, livestock grazing, and other habitat management tools that would provide an economic benefit would be managed through special use permits and would conform to all of our policies. We would work with owners of separated mineral rights to limit potential effects on the surface estate and other associated resources. We would continue to be active and contributing partners in the San Luis Valley Interagency Fire Management Unit. This partnership includes the USDA Forest Service, National Park Service, Bureau of Land Management, the State of Colorado, and the Service.

Across the refuge complex, we would continue to inventory, maintain, rehabilitate, and replace structures, including those with historic significance. When practical, unneeded structures that are not historically significant would be removed and not replaced. We would continue to maintain our fencing, including constructing new fences, removing unnecessary fences, and retrofitting fences for compatibility with wildlife.

Research, Science, and Wilderness Review

Within existing funding levels, we would continue to inventory and monitor habitat and wildlife resources with existing refuge staff as well as by working with the U.S. Geological Survey and other agencies and organizations.

In keeping with current management, we would not recommend additional protection for any areas having wilderness characteristics or values.

Alternative B—Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Draft Proposed Action)

Under this alternative, we would approach management with an emphasis on maintaining or restoring the composition, structure, and function of the natural and modified habitats within the refuge complex. We would consider the ecological site characteristics and wildlife species needs on our refuge lands by developing sound and sustainable management strategies that preserve and restore ecological (biological) integrity, productivity, and biological diversity. We would apply strategic habitat conservation principles (a structured, science-driven, and adaptive approach) in determining how to best manage our lands for native fish, wildlife, and plant species, with a particular emphasis on migratory birds, waterfowl, and declining or listed species. Compatible wildlife-dependent public uses would be enhanced and expanded to include all three refuges. We would facilitate the protection, restoration, and conservation of important water resources through partnerships, public education, and stewardship.

Habitat and Wildlife Resources

We would manage wetland areas within the refuge complex to achieve a variety of wetland types and conditions to support a diversity of migratory birds and other wildlife, with a specific focus on focal species that represent the Service's and other partners' larger conservation goals. To maintain the biological integrity, productivity, and function of our wetland habitat, we would restore historical water flow patterns in specific areas through more effective water management practices. A top priority would be to restore riparian habitat along streams in the Baca National Wildlife Refuge as well as specific areas along the Rio Grande in the Alamosa National Wildlife Refuge. We would manage our upland habitats to create a variety of seral stage conditions that provide habitat for a diverse array of wildlife species, particularly nesting and migratory focal birds. To manage our habitats, we would continue using tools such as prescriptive grazing, haying, fire, mowing, and herbicides.

We would use public hunting to complement the State's management, working together to keep elk populations at levels that would allow us to sustain healthy plant communities both in the refuge complex and on neighboring lands. This would include opening portions of Baca National Wildlife Refuge to public hunting and opening parts of Alamosa and Monte Vista National Wildlife Refuges to a limited public dispersal hunt. We would work with our agency partners (Colorado Parks and Wildlife, National Park Service, USDA Forest Service, Bureau of Land Management, and other conservation organizations) in managing elk populations.

We would work with other Federal and State agencies as well as other conservation partners to improve habitats for threatened and endangered species and other species of concern. Particular focus would be on riparian areas, which provide essential habitat for southwestern willow flycatcher, and riverine systems, which are habitat for Rio Grande sucker and Rio Grande chub. In addition, habitats for other native species of concern such as Gunnison's prairie dog, and northern leopard frog would be protected, restored, and enhanced where practical and necessary.

As with alternative A, the existing arrangement with The Nature Conservancy for bison management on former State lands within the Baca National Wildlife Refuge would be phased out. Since bison are important to other stakeholders and partners, we would research the feasibility, potential, and suitability of introducing semi-free-ranging bison year-round to effectively maintain and enhance certain refuge habitats.

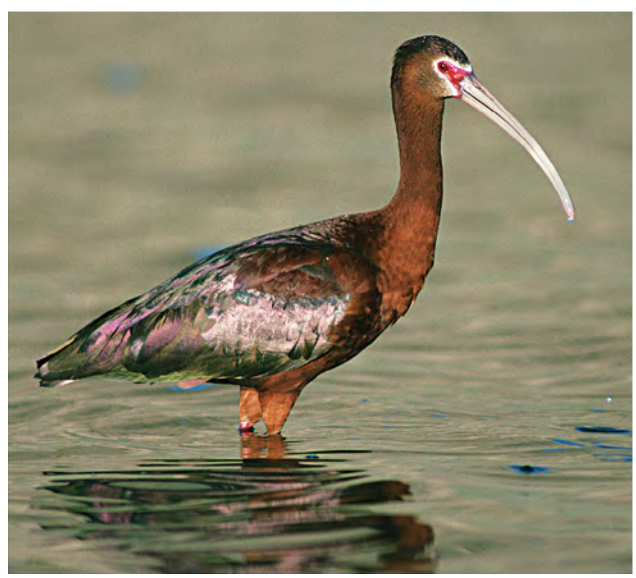
We would continue to grow limited amounts of small grain on the Monte Vista National Wildlife Refuge (about 190 acres) to provide necessary food for the Rocky Mountain population of greater sandhill cranes, as specified in the management plan of the Pacific and central flyways for the Rocky Mountain greater sandhill cranes.

We would control and reduce the incidence of invasive weeds such as tall whitetop, Russian knapweed, Canada thistle, saltcedar, and reed canarygrass through more effective management and by using chemical, mechanical, prescribed fire, and biological control methods. We would make every effort to increase weed control in sensitive habitats or where there is a risk of weeds spreading to neighboring private land.

We would strengthen the fire program within the refuge complex by improving fire management planning and by increasing coordination with partners. We would use prescribed fire to achieve habitat management objectives, and we would conduct prescribed fires at a more acceptable and reliable frequency. We would pursue more funding to protect property and human safety under the wildland-urban interface guidelines, and, where possible, we would reduce the number of individual facilities that would require fire protection.

Water Resources

We would continue to work with other landowners and agencies throughout the watershed to maintain flexibility as well as to protect and, if necessary, aug-



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Tall-emergent vegetation on the refuges provides favorable nesting conditions for colonial waterbirds such as the white-faced ibis.

ment our water rights as State regulations evolve. Water quality standards would be established, and studies initiated to help protect water rights, prioritize habitat management and planning, and develop concise water use reporting methods. Our ground water use would comply with new State ground water rules and regulations through augmentation plans or by working with others and contracting with ground water management subdistricts.

We would achieve our habitat management objectives while providing for quality visitor experiences. Our water infrastructure, delivery, and efficiencies would require upgrades to make sure that habitat and visitor services objectives are met.

Visitor Services

We would continue to offer waterfowl and limited small game hunting on the Monte Vista and Alamosa National Wildlife Refuges. We would open the Baca National Wildlife Refuge for big and small game hunting, and we would offer public dispersal elk hunts and conduct agency dispersal hunting on the Monte Vista and Alamosa National Wildlife Refuges. This would provide recreational opportunities while enabling us to manage the numbers and distribution of elk or other ungulate species. Access points and parking areas would be developed on the Baca National Wildlife Refuge.

General public access would be improved on the Monte Vista and Alamosa National Wildlife Refuges and established on the Baca National Wildlife Refuge. We would allow for more access from about July 15 to February 28 for wildlife viewing and interpretation on roads that are currently open to hunters only during the hunting season. Modes of access such as cross-country skiing and bicycling that facilitate wildlife-dependent uses would be favored on all three refuges. Portions of the Baca National Wildlife Refuge would be opened for limited public use, and nonmotorized access, including walking, biking, and horseback riding, would be allowed. An auto tour route would be built on the Baca National Wildlife Refuge. The construction of more trails or viewing platforms on the Monte Vista and Alamosa National Wildlife Refuges would be considered. Limited commercial opportunities such as photography could be considered. We would seek funding to build a visitor center and refuge complex staff offices at Monte Vista National Wildlife Refuge to better serve the public, provide for safer access to our offices, and provide a modern work environment for our employees. In coordination with the Friends of the San Luis Valley National Wildlife Refuges, which leads this event, we would continue to host the Kid's Fishing Day on the Monte Vista National Wildlife Refuge.

Cultural Resources

Most of our actions would be similar to alternative A, plus we would increase our efforts toward identifying and protecting significant resources.

Partnerships and Refuge Operations

When the Baca National Wildlife Refuge was established under the Great Sand Dunes National Park and Preserve Act of 2000, operations funding did not come with the added management responsibilities. We absorbed these added responsibilities across the refuge complex, which has impacted our operations. In order to meet our future needs, we would seek more funding for the refuge complex for habitat conservation, visitor services, and maintenance. Overall, refuge complex offices are inadequate and provide for little visitor contact. We would seek to increase our staff levels of both full-time and seasonal employees, as well as seek funding for safe access and accessible offices for our staff and visitors.

We would continue to collaborate with Colorado Parks and Wildlife and other agencies to effectively manage elk, which would hopefully result in an improved distribution across the local game management units. We would continue to work closely with the San Luis Valley Interagency Fire Unit to achieve habitat management objectives while minimizing risk to sensitive habitats and human structures. We would seek funding for a more dependable prescribed fire program. We would develop working relationships with neighboring landowners and others to address interface issues such as invasive species control, shared fence management, elk management, and other concerns.

On the Baca National Wildlife Refuge we would work extensively with owners and developers of third-party-owned mineral rights to find ways to reduce the effects of any future exploration activities on visitors and wildlife and to locate exploration and production facilities away from visitors.

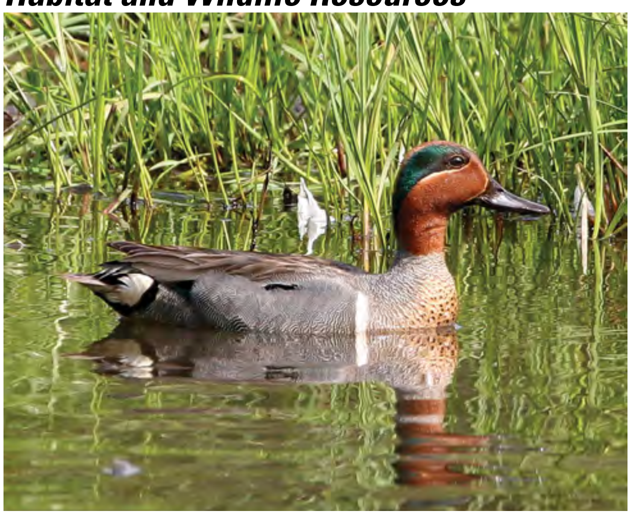
Research, Science, and Wilderness Review

We would increase monitoring efforts, in part to gain an increased understanding of the effects of our management actions on habitat conditions, wildlife populations, and water resources, but also to learn more about the effects of drought and climate change on our wildlife and habitat resources. We would recommend protection of the wilderness values and characteristics found along the eastern boundary of Baca National Wildlife Refuge and adjacent to proposed wilderness on Great Sand Dunes National Park and Preserve (about 13,800 acres). We would manage this area as a wilderness study area to be considered for eventual wilderness designation.

Alternative C—Habitat Restoration and Ecological Processes

We would take all feasible actions to restore or mimic, where needed, the native vegetation community based on ecological site characteristics, ecological processes (hydrologic conditions and other natural disturbances such as grazing and fire), and other abiotic factors. We would continue to provide compatible wildlife-dependent public uses, but they would be adapted in response to changes in area management. Our partnership efforts would be broadened and geared toward restoring native vegetation communities and mimicking natural hydrologic conditions.

Habitat and Wildlife Resources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Waterfowl such as the green-winged teal breed and nest on Alamosa and Monte Vista Refuges.

We would restore vegetative communities in the refuge complex to mimic the ecological conditions that existed before Euro-American settlement of the area. For example, we would restore the function of both the riparian areas and playas on the Baca National Wildlife Refuge and identify potential habitat conditions for the three refuges.

We would apply natural disturbance regimes such as prescribed grazing and fire in other habitats. Where practical, we would restore natural waterflow patterns. We would end production of small grains for migrating sandhill cranes on the Monte Vista National Wildlife Refuge.

We would use hunting to manage elk populations or their distribution and improve the long-term health of riparian habitat. Similar to alternative B, our priority would be to improve habitat for all native species, but particularly threatened and endangered species and other species of concern. For example, we would actively restore additional cottonwood and willow riparian areas for southwestern willow flycatcher along the Rio Grande on the Alamosa National Wildlife Refuge and reintroduce Rio Grande chub and Rio Grande sucker along creeks on the Baca National Wildlife Refuge where they historically occurred.

As with alternative B, we would phase out the existing arrangement with The Nature Conservancy for bison on former State lands. Knowing that bison occurred historically to some extent in the San Luis Valley, we would attempt to periodically (not every year) use bison on the Baca National Wildlife Refuge to mimic the ecological benefit they may have once provided.

Similar to alternative B, we would intensify our efforts to combat invasive plants. Steps would be taken to strengthen the fire program within the refuge complex and use prescribed fire to restore and maintain native plant communities.

Water Resources

We would manage water to restore the hydrologic conditions with less focus on habitat management for specific species or for providing wildlife viewing. We would evaluate the need to supplement existing water supplies while considering restoration of historic hydrology, especially on the Monte Vista and Alamosa National Wildlife Refuges. In some years, water might not be available to meet life cycle needs for some waterfowl species. Existing water infrastructure would be removed or modified as needed. Water quality monitoring would also be increased.

Visitor Services

We would continue to allow waterfowl and limited small game hunting on the Monte Vista and Alamosa National Wildlife Refuges. Similar to alternative B, we would open the Baca National Wildlife Refuge for big game and small game hunting. On the Monte Vista and Alamosa National Wildlife Refuges, we would rely on public hunting or agency dispersal methods for elk management.

There may be changes in public use, depending on the habitat management action. Some areas could be closed. Current public access would be evaluated on the Alamosa and Monte Vista National Wildlife Refuges. If existing roads or trails are not needed or if these facilities fragment habitat, they could be removed or altered. Viewing areas for sandhill cranes may be moved, depending on restoration efforts. Service participation in the Monte Vista Crane Festival could be adjusted, depending on changes in the location and concentration of sandhill cranes. We would provide on-site interpretation and environmental education programs on the Alamosa and Monte Vista National Wildlife Refuges as funding allows, and our key messages would relate to our restoration efforts. Similar to alternative B, we would also allow for walking and biking on trails and roads within the hunt boundary from July 15 to 28.

Except for limited hunting access to achieve management objectives, there would be no facilities or programs on the Baca National Wildlife Refuge. For example, an auto tour route, nature trails, and restrooms would not be developed.

Cultural Resources

Actions would be similar to those under alternative B.

Partnerships and Refuge Complex Operations

We would seek to increase partnerships with a variety of agencies, organizations, and universities to achieve management objectives, restore ecological processes, and improve the efficiency of overall refuge management operations. On the Baca National Wildlife Refuge, current Lexam and gravel roads would be evaluated, and roads that are not needed or that are fragmenting habitat would be removed. As with alternative A, the use of haying, livestock grazing, and other habitat management tools with an economic benefit would be managed through special use permits and would conform to all Service policies.

Research, Science, and Wilderness Review

Similar to alternative B, we would increase efforts in studying habitats and wildlife, particularly with respect to climate change as well as land and water protection.

Similar to alternative B, we would recommend protection of the wilderness values and characteristics found along the eastern boundary of Baca Refuge (about 13,800 acres).

Alternative D—Maximize Public Use Opportunities

We would manage wildlife and habitats on the refuge complex consistent with our mission and purposes of the refuges while emphasizing quality visitor experiences and compatible wildlife-dependent public uses. Partnerships that complement our efforts to accommodate and provide for the priority public uses would be strengthened.

Habitat and Wildlife Resources

Similar to alternative A, we would manage wetlands to maximize waterbird production at the Monte Vista and Alamosa National Wildlife Refuges. We would also irrigate areas that are closer to public access and viewing areas at the Baca Refuge to enhance wildlife viewing. Riparian and upland habitats would be conserved for migratory birds. We

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Environmental education programs on Alamosa Refuge provide opportunities for children to learn about nature.

would increase the agricultural production of small grains for sandhill cranes on the Monte Vista National Wildlife Refuge (about 230 acres), and grain production could also be used in a specific place or time to enhance wildlife viewing. A key difference from alternatives A and C, but similar to alternative B is that we would improve public education about and interpretation of the role that the refuge complex plays in the San Luis Valley and across the National Wildlife Refuge System.

We would offer opportunities for elk hunting and viewing. Elk numbers would be managed at levels that would restore and foster the long-term health of native plant communities.

We would collaborate with other agencies for public access, law enforcement, and management of elk. Similar to alternative B, habitats for native species and threatened, endangered, and other species of concern would be improved, but we would emphasize public education in our restoration efforts.

Similar to alternatives B and C, the existing arrangement with The Nature Conservancy for bison management on former State lands at the Baca National Wildlife Refuge would be phased out. We would introduce and manage a small bison herd on a confined area of the Baca National Wildlife Refuge. Wildlife viewing and interpretation opportunities would be emphasized and incorporated into this program.

Similar to all the other alternatives, invasive and noxious weeds would be controlled using chemical, mechanical, or manual methods or through the use of livestock grazing. Under this alternative, however, public education and awareness of the effects that invasive weeds have on native plant communities would be a key message for interpretation.

As under all alternatives, prescribed fire would be used. There would be a concerted effort to talk with the public about the role of fire on the landscape and garner support for strengthening the fire program. Similar to alternative B, we would pursue more funding for the protection of human safety following local, State, and National guidelines and strategies, but would limit having to maintain facilities that could increase the Service's legal obligations on and off the site.

Water Resources

We would manage water in a manner similar to alternative B except that more effort would be given to making sure there is water in specific areas or at specific times to enhance wildlife viewing. The spatial distribution of water would be managed to make the visitor's experience richer. A high priority would be placed on maintaining operation of wells that provide important wildlife viewing habitat. All of our wells will be augmented and will comply with Colorado water law. More water could also improve viewing opportunities. Ground water and surface water could be used to enhance areas used by sandhill cranes or provide more opportunities to see wildlife rather than merely providing for the life cycle needs of species less important to public uses. Similarly, we would improve infrastructure in areas that are highly valued by visitors to better facilitate wildlife observation. Water quality monitoring would be increased, and collaboration with a citizen scientist group or with schools or universities would be sought out.

Visitor Services

This alternative would provide for the widest variety of compatible wildlife-dependent recreation. We would encourage and provide for big game hunting on the Baca National Wildlife Refuge, with public dispersal hunts on the Monte Vista and Alamosa National Wildlife Refuges and limited small game hunting opportunities for all, including youth hunts and considerations for accessibility. Similar to alternative B, access would be expanded for all refuges, including opening the Baca National Wildlife Refuge for public uses. More trails, viewing blinds, restrooms, parking areas, and access points would be constructed.

Although our responsibilities for habitat and wildlife management come first, we would also consider and emphasize visitor experience when designing or locating visitor access or using existing infrastructure. With more staff and volunteers to support a wider range of compatible programs and facilities, we would increase interpretation and educational opportunities. Limited fishing access would be allowed on the Alamosa National Wildlife Refuge. Commercial uses, such as photography or art groups, would be considered. Public education and interpretation would highlight how visitor behavior can be modified to reduce wildlife disturbance.

Cultural Resources

Actions would be similar to alternative B, except there would be a greater emphasis on using students or volunteers to survey areas with high potential for cultural resources. We would work with local and tribal educators to develop interpretive materials.

Partnerships and Refuge Complex Operations

Actions would be similar to alternative B, except we would pursue more partnerships and funding for priority public uses as well as securing resources to protect, enhance, and interpret significant cultural resources.

Similar to alternative B, we would work with mineral developers to place resource extraction away from public use facilities.

Research, Science, and Wilderness Review

Similar to alternative B, we would increase efforts to study habitats and wildlife, particularly with respect to understanding the effects of climate change and its effects on the resources of the San Luis Valley. How climate change affects the resources on the refuge complex would be incorporated into public use themes and messages.

Similar to alternatives B and C, we would recommend that wilderness values on the Baca National Wildlife Refuge be protected.

Affected Environment

The draft CCP and EIS describes the characteristics and resources of the refuge and how existing or past management or other influences have affected these resources. The affected environment addresses the physical, biological, and social aspects of the refuge complex that could be affected by management under the four alternatives. These aspects include the physical and biological environment, visitor services, cultural resources, special management areas, and the socioeconomic environment. We used published and unpublished data as noted in the bibliography to quantify what we know about the refuge complex resources.

Environmental Consequences

The alternatives for managing the refuge complex would provide a variety of positive effects (benefits) as well as potential negative effects (impacts) to the resources of the refuge complex. Under alternatives B–D, some of the greatest benefits would come from restoration of riparian habitat along the creek drainages on the Baca National Wildlife Refuge and where possible by improving the hydrology and function of selected areas along the Rio Grande through the Alamosa National Wildlife Refuge. In particular, this would benefit several focal bird species including southwestern willow flycatcher and western wood pewee.

There would be minor improvements for general public access under alternative C on the Monte Vista and Alamosa National Wildlife Refuges, but only limited access would be allowed on the Baca National Wildlife Refuge. A significant benefit for the refuge complex would occur from opening Baca National Wildlife Refuge to small and big game hunting, and opening Monte Vista and Alamosa National Wildlife Refuges to limited big game hunting. In addition to providing additional recreational opportunities across the refuge complex, these hunting opportunities would enable us manage the numbers and distribution of elk.

Generally, the restoration activities described under alternatives B, C, and D provide many long-term benefits to refuge complex resources, but there would be some short-term negative impacts, although most could be minimized. Disturbance caused by activities such as planting, fencing, use of prescribed fire, grazing, and mowing could result in localized, short-term erosion, soil loss, and even the release of soil particles (dust) into the air. Upon project completion and revegetation, soil protection and productivity would be preserved. Sediment that was being retained behind an existing levee would be pulled


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Under alternatives B–D, some of the greatest benefits would result from restoration of riparian habitat along the creek drainages on Baca National Wildlife Refuge.

down to the next levee. There would be negligible changes to soil resources under alternatives A and D. Under alternatives B and C, restoration activities would require more removal of levees, ditches, dikes, and ponds. Restoration could be as simple as removing a board or other infrastructure, but could also require more disturbance. As with wetland habitat, the restoration of former agricultural fields could result in negligible erosion to soils. Under alternative C, the potential for soil erosion would be greater than under B due to increased restoration of upland areas. All restoration activities would follow a phased approach, and would reduce the amount of soil disturbance at any given time. On the Baca National Wildlife Refuge, under alternatives B–D, the restoration of riparian habitat would require the need for heavy equipment, which would result in more short-term minor to major disturbances to soils. The development of visitor services facilities under alternative B would result in minor to moderate short-term disturbances to soils. Negative impacts could be reduced by following best management practices such as controlling erosion, minimizing grading, and installing culverts where necessary.

Under alternatives A, B, and D, over the long-term, there would be negligible to minor short-term impacts for waterfowl hunting due to limited water availability and reduced hunting participation and minor to moderate long-term impacts due to a continued reduction in available water to support waterfowl. This would be offset with minor to moderate benefits for small and big game hunting opportunities across the refuge complex with the opening of Baca National Wildlife Refuge to hunting and limited big game hunting on the Monte Vista and Alamosa National Wildlife Refuges. Alternative C would result in moderate long-term impacts to waterfowl opportunities due to less water availability.

Under alternatives B–D, with successful restoration of willow and cottonwood riparian areas along the Rio Grande, there would be minor long-term benefits for southwestern willow flycatcher due to habitat enhancement efforts along the Rio Grande. However, under alternatives B and C, there could be minor impacts to southwestern willow flycatcher from increased trail use along Rio Grande nature trail on the Alamosa National Wildlife Refuge and from increased access for biking and walking during the period from July 15 to about September 1, when birds are still on the refuge. This would affect the portions of the Rio Grande trail and the southern loop that follow along the river. Under alternative D, impacts could increase to moderate levels with the addition of allowing for fishing access. With mitigation measures put into place, such as requiring visitors to stay on the nature trails, rerouting a portion of a trail, improving signage, increasing education and law enforcement, and use closures if needed, any negative impacts to southwestern willow flycatcher would be minimized.

Under alternatives A, B, and D, continuing to provide agricultural grains for greater sandhill cranes would continue to provide minor to moderate benefits for cranes migrating through the San Luis Valley as well as for wildlife viewing. Alternative C would result in moderate to even major long-term impacts for crane migration through the San Luis Valley in addition to wildlife viewing.

Concerning the use of bison on the Baca National Wildlife Refuge as a management tool and the ability of the larger landscape to support bison conservation, there would be no effect under alternative A, alternative B would provide a minor long-term benefit for habitat and bison conservation, and alternative C would provide negligible benefits for habitat and bison conservation. Under alternative D, a small demonstration herd would result in minor benefits for bison conservation.

For elk management, there would negligible long-term benefits from our ongoing population management efforts. Elk would continue to have moderate impacts on riparian habitats on the Baca National Wildlife Refuge and Alamosa National Wildlife Refuges. Under alternatives B, C, and D, there would be minor to moderate benefits for population and disease management as well as benefits for riparian habitat.

Concerning lands that have wilderness values, under alternative A, there would be no further protections afforded these lands other than our refuge management policies and the guidance afforded in the CCP. Existing wilderness values could be negatively affected, but the level of effects would be negligible to minor. Under alternatives B, C, and D, the wilderness values and characteristics along the eastern boundary of Baca National Wildlife Refuge would be protected long term, resulting in moderate benefits for wilderness values and the characteristics of the Great Sand Dunes ecosystem.

Under all alternatives, there would be negligible benefits or effects to the regional economy. Under alternative A, the total economic impact is 13 jobs; under alternative B, two additional jobs would be added; alternative C would be similar to alternative A; and under alternative D, five new jobs would be added.

What Happens Next?

The draft CCP and EIS will be available for a 60-day public review. Following the review, we may change the alternatives, the impact analysis, or other features as a result of the comments we receive. We will then revise the draft document and produce a final CCP and EIS for distribution. It will identify any changes we made to our preferred alternative.

Our final decision will be documented in a record of decision that is published in the Federal Register, no sooner than 30 days after we file the final CCP and EIS with the U.S. Environmental Protection Agency and have distributed it to the public. We will begin to implement our final stand-alone CCP immediately upon publication of the decision in the Federal Register. Selected management activities will be implemented as funds become available. The final CCP does not constitute a commitment for funding, and future budgets could influence our implementation priorities.

Abbreviations

ACEC	Area of Critical Environmental Concern
AFY	acre-feet per year
Alamosa Refuge	Alamosa National Wildlife Refuge
ATV	all-terrain vehicle
AUM	animal-unit month
Baca Refuge	Baca National Wildlife Refuge
BCR 16	Southern Rockies Bird Conservation Region
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
CCP	comprehensive conservation plan
CFR	Code of Federal Regulations
cfs	cubic feet per second
CNEL	Community noise equivalent level
CO_2	carbon dioxide
CPW	Colorado Parks and Wildlife; formerly Colorado Division of Wildlife (CDOW)
dB	decibel
dBA	A-weighted decibel
DOI	U.S. Department of the Interior
EIS	environmental impact statement
FWS	U.S. Fish and Wildlife Service
GIS	Geographic Information System
GMU	game management unit
gpm	gallons per minute
GPS	Global Positioning System
GS	General Schedule employment type
HCP	habitat conservation plan
HMP	habitat management plan
IMPLAN	Impact Analysis for Planning

Improvement Act	National Wildlife Refuge System Improvement Act of 1997
Ldn	day-night level
Leq	equivalent energy noise level
MBCC	Migratory Bird Conservation Commission
Monte Vista Refuge	Monte Vista National Wildlife Refuge
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
Refuge complex	San Luis Valley National Wildlife Refuge Complex, Alamosa, Monte Vista, and Baca National Wildlife Refuges
Refuge System	National Wildlife Refuge System
Region 6	Mountain-Prairie Region of the U.S. Fish and Wildlife Service
RLGIS	Refuge Land Geographic Information System
SEL	sound exposure limit
Service	U.S. Fish and Wildlife Service
TEA–21	1998 Transportation Equity Act for the 21st Century
TES	threatened and endangered species
TNC	The Nature Conservancy
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USFS	USDA Forest Service
USGS	U.S. Geological Survey
WG	wage grade employment type
WSA	wilderness study area
	Definitions of these and other terms are in the glossary.

Chapter 1—Introduction

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Early morning light on Monte Vista National Wildlife Refuge.

We, the U.S. Fish and Wildlife Service (Service), have developed this draft comprehensive conservation plan (CCP) and environmental impact statement (EIS) to describe alternatives and potential consequences for the management and use of three national wildlife refuges within San Luis Valley National Wildlife Refuge Complex (refuge complex, the refuges). The refuge complex is made up of four units of the National Wildlife Refuge System (Refuge System): Monte Vista National Wildlife Refuge, Alamosa National Wildlife Refuge, Baca National Wildlife Refuge, and the Sangre de Cristo Conservation Area. These units are located in Alamosa, Saguache, Rio Grande, and Costilla counties in Colorado and Rio Arriba and Taos counties in New Mexico (see vicinity map, figure 1). Although the Sangre de Cristo Conservation Area is part of the refuge complex, it is managed under a separate land protection plan (FWS 2012) and is not included in this CCP.

The CCP is being developed in compliance with the National Wildlife Refuge Administration Act of 1966, as amended (16 U.S.C. 668dd et seq.), also known as the Improvement Act, and Part 602 (National Wildlife Refuge System Planning) of the "Fish and Wildlife Service Manual" (FWS 2000c) and other Service guidelines. The actions described in the CCP also meet the requirements of the National Environmental Policy Act of 1969 (NEPA; refer to appendix A). Wildlife conservation, including habitat conservation, is the Service's first priority for managing national wildlife refuges. Public uses, specifically wildlife-dependent recreational uses, are allowed and encouraged as long as they are compatible with the establishment purposes of each refuge.

The draft CCP and EIS for the refuge complex discusses program levels that are sometimes substantially above current budget allocations and, as such, are primarily for strategic planning purposes. Once completed, the CCP will specify the actions that are necessary to achieve the vision and goals of the refuge complex, and it will guide the management activities, programs, and actions for the 15 years following approval.

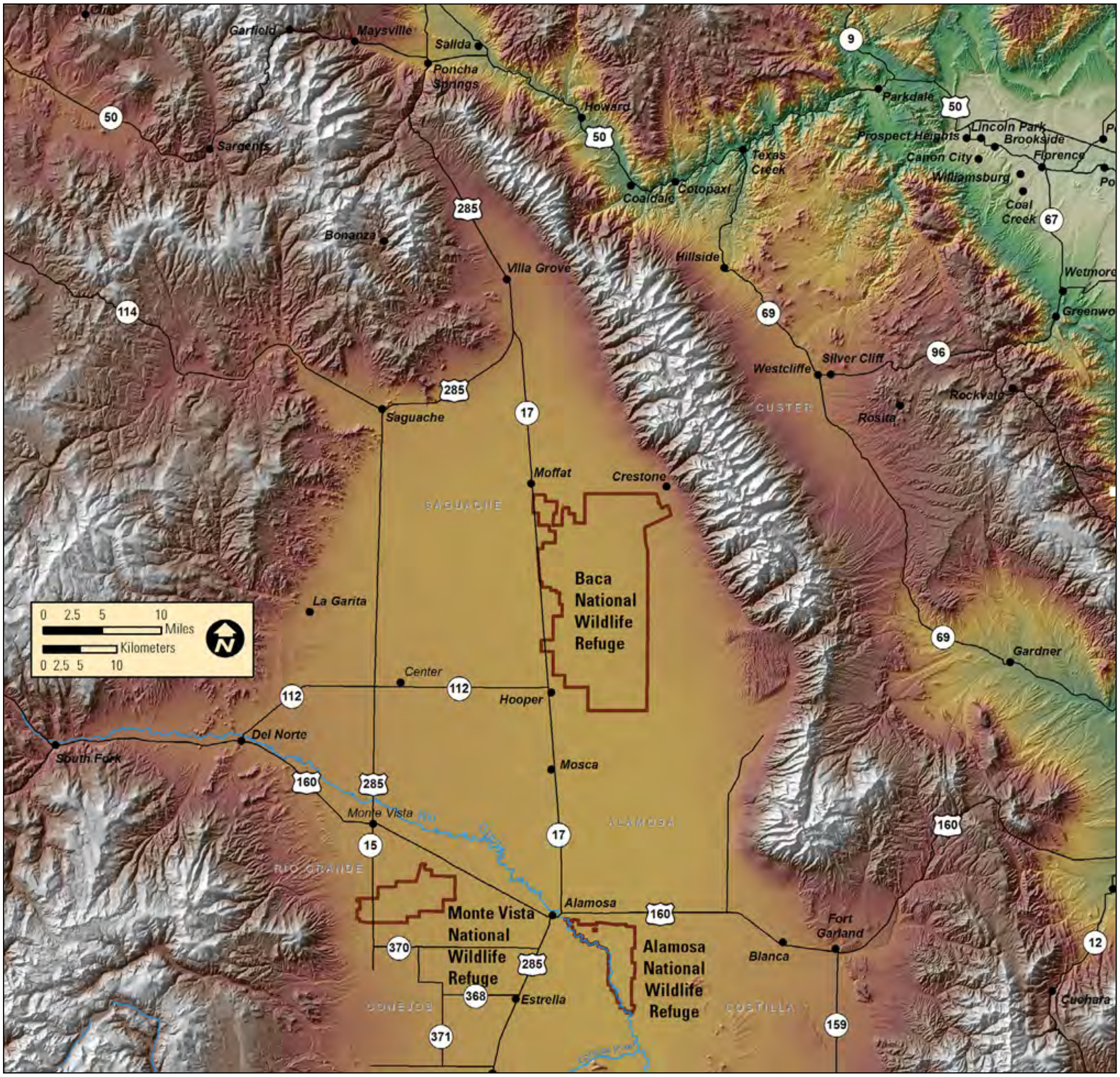

Figure 1. Vicinity map of the San Luis Valley National Wildlife Refuge Complex, Colorado.

We have formulated four draft alternatives that have been developed through both extensive public input and collaboration with several Federal, State, and local agencies that have close ties to the refuges. The core planning team of representatives from several Service programs prepared this draft CCP and EIS. (Refer to appendix B.) In addition, the following cooperating agencies were on the planning team:

- Bureau of Land Management (BLM) (San Luis Valley Public Lands Center)
- Bureau of Reclamation (BOR)
- USDA Forest Service (Forest Service) (San Luis Valley Public Lands Center)
- National Park Service (NPS)
- Natural Resources Conservation Service (NRCS)
- Colorado Parks and Wildlife (CPW) (formerly Colorado Division of Wildlife)
- Colorado Water Resources Division

Public involvement in the planning process is discussed in section 1.6 below and in further detail in appendix C.

The planning team used comments that were received during two public comment periods (one for scoping and one for draft alternatives) in conjunction with a list of the management needs of the refuges to develop four sets of alternatives, objectives, and strategies for management of the refuge complex. Details of the no-action alternative and three action alternatives are in Chapter 3–Alternatives, and the predicted effects of the alternatives are described in Chapter 5–Environmental Consequences. We have identified one alternative as the proposed action.

1.1 Purpose and Need for Action

The purpose of this draft CCP and EIS is twofold: to describe the role of each refuge in the complex in supporting the mission of the Refuge System and to provide long-term guidance for management of refuge programs and activities. The CCP is needed to help us achieve the following:

- communicate with the public and other partners about our efforts to carry out the mission of the Refuge System and meet the purposes of the refuges;
- provide a clear statement of direction for management of the refuge complex;
- ensure that the refuges within the refuge complex continue to conserve fish, wildlife, and ecosystems despite current challenges such as drought, water shortages, and the effects of climate change;
- provide neighbors, visitors, and government officials with an understanding of our management actions on and around the refuge complex;
- ensure that our management actions are consistent with the mandates of the Improvement Act;
- ensure that management of the refuge complex considers other Federal, State, and local government plans; and
- provide a basis for development of budget requests for the operation, maintenance, and capital improvement needs of the refuge complex.

We are committed to sustaining the Nation's fish and wildlife resources through the combined efforts of governments, businesses, and private citizens.

Decision to Be Made

The Regional Director of the Mountain-Prairie Region will make the final decision on the preferred alternative for the CCP. The regional director's decision will be based on our legal responsibilities, including the mission of the Service and the Refuge System; other legal and policy mandates; the purposes of each national wildlife refuge within the San Luis Valley Refuge Complex; and the vision and goals identified in this draft CCP.

Our final decision will be documented in a record of decision that will be published in the Federal Register no sooner than 30 days after filing the final CCP and EIS with the Environmental Protection Agency and distributing it to the public. We will begin to carry out the selected alternative identified in the final CCP immediately following publication of the decision in the Federal Register.

1.2 U.S. Fish and Wildlife Service and Refuge System

We are the principal Federal agency responsible for fish, wildlife, and plant conservation. The Refuge System is one of our major programs.

U.S. Fish and Wildlife Service

The Service was established in the Department of the Interior (DOI) in 1940 through the consolidation of bureaus then operating in several Federal departments. The primary precursor agency was the Bureau of Biological Survey in the U.S. Department of Agriculture (USDA). Today, we enforce Federal wildlife laws, manage migratory bird populations, restore nationally significant fisheries, conserve and restore vital wildlife habitat, protect and recover endangered species, and help other agencies and governments with conservation efforts. In addition, we administer a Federal aid program that distributes hundreds of millions of dollars to States for fish and wildlife restoration, boating access, hunter education, and related programs.

Our mission is working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.

Service Activities in Colorado

Our activities in Colorado contribute to the State's economy, ecosystems, and education programs. The following list describes some of our activities:

- We manage nine units of the Refuge System plus other acreage along the Colorado River for a total area of 339,760 acres. (FWS 2013a). We also manage two fish hatcheries with a total area of 3,208 acres, two coordination areas with a total area of 1,153 acres, and one administrative site (FWS 2013a).

- We provide millions of dollars annually to Colorado Parks and Wildlife for sport fish and wildlife restoration and hunter education under the Pittman-Robertson Act of 1937 and the Dingell-Johnson Act of 1950. (FWS 2013n).

- For more than 20 years, our Partners for Fish and Wildlife Program (Partners program) has helped to restore more than 29,647 wetland acres, 296 linear miles of streams, and 104,910 upland acres in Colorado (FWS 2013l).

- In 2011, we paid Colorado counties $491,087 under the Refuge Revenue Sharing Act for use in schools and for roads (FWS 2013m).

National Wildlife Refuge System

In 1903, President Theodore Roosevelt designated the 5.5-acre Pelican Island in Florida as the Nation's first wildlife refuge to protect nesting colonies of brown pelicans, egrets, and other birds. This was the first time the Federal Government had set aside land specifically for wildlife. This small but significant designation was the beginning of the National Wildlife Refuge System.

Since then, the Refuge System has become the largest collection of lands in the world specifically managed for wildlife, with at least one refuge in every State and in five U.S. territories and Commonwealths. These units of the Refuge System vary widely in size, purpose, origin, climate, level of development and use, and degree of Federal ownership (Fischman 2005, FWS 2013j).

Historically, most refuge-establishing statutes that authorized acquisition of national wildlife refuge lands gave broad authority to the Service for managing lands for wildlife. However, in many cases the establishing authorities lacked specific direction or procedures for uniform management of the acquired and reserved lands. To resolve this, Congress passed two statutes in the 1960s to provide administrative guidance: the Refuge Recreation Act of 1962 and the

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The American avocet is one of many shorebirds that migrate through the San Luis Valley National Wildlife Refuge Complex.

National Wildlife Refuge System Administration Act of 1966 (Administration Act). (Refer to appendix A.) While the Administration Act consolidated the units under our jurisdiction, it still did not meet its goal of giving clear direction for Refuge System management. The Administration Act gave the Secretary of the Interior broad power to decide what secondary uses could occur on national wildlife refuges, but it did not provide any biological standards or other standards of review outside of the establishing purposes. Furthermore, Congress did not specify a definition for compatible uses or provide any other direction on making such a determination (Tredennick 2000).

In the late 1980s, a decline in migratory bird populations prompted a General Accounting Office study of how refuge management activities negatively affected these populations (General Accounting Office 1989, U.S. House of Representatives 1997). The report concluded that the focus on secondary uses of refuges diverted refuge managers' attention and resources away from wildlife management. In the early 1990s, several environmental organizations sought to end recreational and economic uses of refuges because of alleged incompatibility with wildlife conservation, and these organizations challenged the Service through several lawsuits (Tredennick 2000). Eventually, the Service settled the lawsuits by changing or eliminating several existing uses of refuge lands. The pressure for new legislation intensified as a direct result of these lawsuits and other concerns, and the ground was laid for passage of a bill that would give us a clear mission and help resolve the problems of the past (U.S. House of Representatives 1997). Finally, on October 9, 1997, Congress passed into law the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act). The Improvement Act established a clear vision for the Refuge System.

The Improvement Act (and associated regulations) states that each national wildlife refuge must be managed to:

- "fulfill the mission of the System, as well as the specific purposes for which that refuge was established";
- consider "wildlife conservation… [as] the singular National Wildlife Refuge System mission" (Final Compatibility Regulations Pursuant to the National Wildlife Refuge System Improvement Act of 1997; FWS 2000a);
- "ensure that the biological integrity, diversity, and environmental health of the System are maintained";
- fulfill the requirements of preparing "a comprehensive conservation plan… for each refuge within 15 years after the date of enactment of the… Act" and of ensuring opportunities for "public involvement in the preparation and revision of [these] plans";
- recognize that "compatible wildlife-dependent recreation [fishing, hunting, wildlife observation and photography, and environmental education and interpretation] is a legitimate and appropriate general public use of the System"; and
- keep the authority of a refuge manager to "make… the compatibility determination" after exercising "sound professional judgment… regarding wildlife conservation and uses of the National Wildlife Refuge System" (Final Compatibility Regulations Pursuant to the National Wildlife Refuge System Improvement Act of 1997; FWS 2000a).

We started following the direction of the new legislation immediately after the passage of the Improvement Act, including the preparation of CCPs for all national wildlife refuges and wetland management districts. Following the mandates of the Improvement Act, we encourage public involvement in the preparation of all CCPs.

People and the Refuge System

The Nation's fish and wildlife heritage contributes to the quality of American lives and is an integral part of the country's greatness. Wildlife and wild places have always given people special opportunities to have fun, relax, and appreciate the natural world.

Wildlife-dependent recreation contributes millions of dollars to local economies, whether through birding, fishing, hunting, photography, or other wildlife-related pursuits. Nearly 46.5 million people visited national wildlife refuges in 2011 (Carver and Caudill 2013), mostly to observe wild animals in their natural habitats. Refuge visitors enjoy nature trails, auto tours, interpretive programs, and hunting and fishing opportunities. Local communities that surround the refuges and districts receive significant economic benefits. Economists report that Refuge System visitors contribute more than $2.4 billion annually to local economies, and 72 percent of this money is generated by non-consumptive activities (Carver and Caudill 2013).

Compatible Refuge Uses

Lands within the Refuge System are different from other Federal lands that have multiple-use purposes in that Refuge System lands are closed to the public upon acquisition unless specifically and legally opened. A refuge use is not allowed unless the Service finds the use to be compatible (FWS 2000a). We cannot allow a new use of a refuge or expand, renew, or extend an existing use of a refuge unless the Secretary has decided that the use is a compatible one and is consistent with public safety. A compatible use is one that, in the sound professional judgment of the refuge manager, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuge. "Sound professional judgment" is defined as a decision that is consistent with the principles of fish and wildlife management and administration, the available science and resources, and adherence to the law.

Draft compatibility determinations for existing and new uses for the refuge complex are found in appendix D. A compatibility determination is the written documentation that an existing or proposed use of a national wildlife refuge either is or is not compatible with the purposes of the refuge. Following public review, a final determination is made about the compatibility of various uses. Subsequently, the determination is signed and dated by the refuge manager with the concurrence of the assistant regional director for the Refuge System. Compatibility determinations are typically completed as part of the process for a CCP or stepdown management plan. Once a final compatibility determination is made, it is not subject to administrative appeal.

The Improvement Act states that six priority uses—hunting, fishing, wildlife observation, photography, interpretation, and environmental education—should receive consideration in planning and management over other public uses. All other uses, including livestock grazing and commercial recreation, require compatibility determinations. However, refuge management activities such as prescribed fire or invasive plant control do not require compatibility determinations.

Biological Integrity, Diversity, and Environmental Health

Central to the Improvement Act is the requirement that the biological integrity, diversity, and environmental health of the Refuge System be kept for the benefit of present and future generations of Americans. In 2001, we published a policy with guidance on this topic (FWS 2001). This policy presents a directive for refuge managers to follow while achieving the purposes of the refuge and the Refuge Sys-

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Wetland on Monte Vista National Wildlife Refuge.

tem mission. The refuge manager is to consider the broad spectrum of fish, wildlife, and habitat resources found on the refuge and associated ecosystems. The policy defines the terms "biological integrity," "diversity," and "environmental health," and provides direction for secondary economic uses like farming, haying, logging, livestock grazing, and other extractive activities. These are permissible habitat management practices only when prescribed in plans to meet wildlife or habitat management objectives and only when more natural methods, such as fire or grazing by native herbivores, cannot meet refuge purposes and goals. As stated above, a compatibility determination is required for these uses.

1.3 National and Regional Mandates

Refuge System units are managed to achieve the mission and goals of the Refuge System, along with the designated purposes of the refuges, conservation areas, and wetland management districts as described in establishing legislation, Executive orders, or other establishing documents. Key concepts and guidance for the Refuge System are in the National Wildlife Refuge System Administration Act of 1966, as amended by the Improvement Act (16 United States Code [U.S.C.] 668dd et seq.) and further detailed in Title 50 of the Code of Federal Regulations (CFR) and the "Fish and Wildlife Service Manual."

Brief descriptions of the laws and Executive orders that may affect the development or implementation of this CCP are in "Appendix A, Key Legislation and Policy." Service policy for the planning process and management of refuges and districts is found in the "Fish and Wildlife Service Manual."

Strategic Habitat Conservation

Escalating challenges such as land use conversion, invasive species, water scarcity, and climate change have led us to move away from our earlier approach to conservation, which emphasized ecosystems, toward the broader vision that emphasizes landscape conservation in partnership with others.

A cooperative effort by the Service and the U.S. Geological Survey (USGS) culminated in a report on strategic habitat conservation by the National Ecological Assessment Team (USGS and FWS 2006). This report outlined a unifying and adaptive resource management approach for landscape-scale conservation of a priority species or suite of species. This is strategic habitat conservation—a way of thinking and doing business by incorporating biological goals for priority species populations, by making strategic decisions about the work needed, and by constantly reassessing and refining our approach (figure 2).

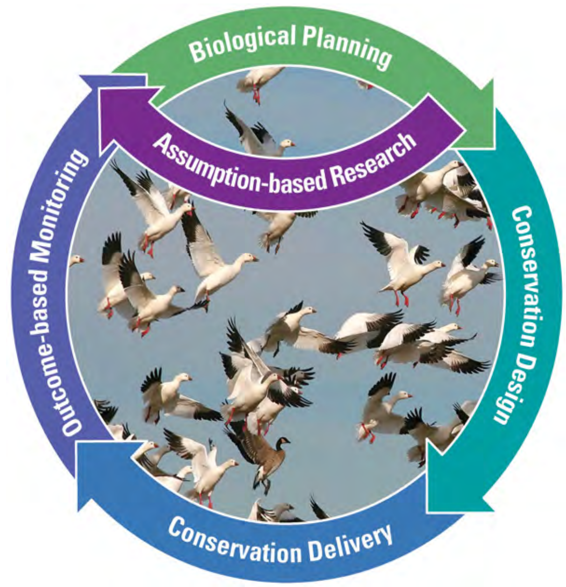

Figure 2. Basic strategic habitat conservation process.

Since 2006, we have taken significant steps to turn this vision into a reality, and we have defined a framework of 22 geographic areas. The Service and the USGS developed this framework through an aggregation of bird conservation regions (figure 3). The refuge complex lies within the Southern Rockies Geographic Area (figure 4).

We have used this framework as the basis to establish the first generation of landscape conservation cooperatives. These cooperatives are conservation–science partnerships between the Service and other Federal agencies, States, tribes, nongovernmental organizations, universities, and others. Designed as fundamental units for planning and science, the cooperatives have the capacity to help us carry out the elements of strategic habitat conservation: biological planning, conservation design and delivery, and monitoring and research. Coordinated planning and scientific information will strengthen our strategic response to accelerating climate change and other challenges. Because the sheer number of species that we and our partners work with makes designing and conserving landscape-scale habitats impractical on a species-by-species basis, we are now developing a process to collaboratively identify sur-

Figure 3. Map of the bird conservation regions in North America.

rogate species, or species that can represent a suite of other species or aspects of the environment such as habitat or water quality. For more information about surrogate or focal species, refer to chapters 3 and 4.

Climate Change

We expect that accelerating climate change will affect the Nation's fish, wildlife, and plant resources in profound ways. While many species will continue to thrive, some may decline and some may go extinct. Some species will survive in the wild only through direct and continuous intervention by managers. In 2010, we completed a strategic plan to address climate change for the next 50 years. The strategic plan employs three key strategies: adaptation, mitigation, and engagement. In addition, the plan acknowledges that no single organization or agency can address climate change without allying itself with others in partnerships across the Nation and around the world (FWS 2010). This strategic plan is an integral part of DOI's strategy for addressing climate change as expressed in Secretarial Order 3226 and updated by Order 3289 (DOI 2009). Order 3226 states "there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decisionmaking" (see chapter 4, section 4.2.2). Furthermore, we are employing the national fish, wildlife, and plants climate adaptation strategy (National Fish, Wildlife, and Plants Climate Adaptation Partnership 2012), which is a call to action to work with other natural resource professionals and decisionmakers to conserve the nation's fish, wildlife, plants, and natural systems in a changing climate.

We will use the following guiding principles from the strategic plan (FWS 2010) in responding to climate change:

- Priority setting—Continually evaluate priorities and approaches, make difficult

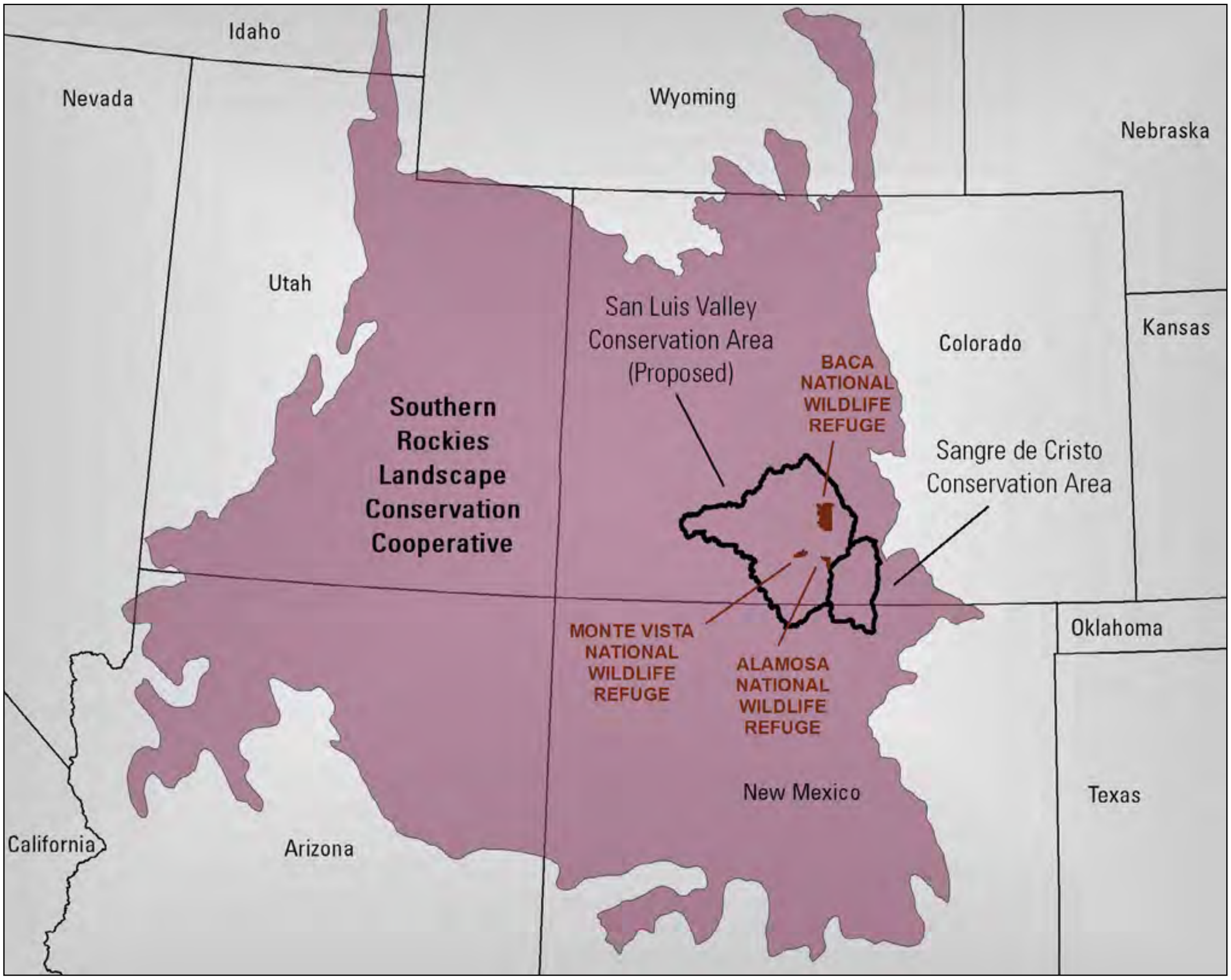

Figure 4. Map of the South Rockies Geographic Area.

choices, take calculated risks, and adapt to climate change.

- Partnership—Commit to a new spirit of coordination, collaboration, and interdependence with others.

- Best science—Reflect scientific excellence, professionalism, and integrity in all of our work.

- Landscape conservation—Emphasize the conservation of habitats within sustainable landscapes, applying our strategic habitat conservation framework.

- Technical capacity—Assemble and use state-of-the-art technical capacity to meet the climate change challenge.

- Global approach—Be a leader in national and international efforts to meet the climate change challenge.

Conserving the Future

In 1999, we developed a vision for the Refuge System. A report titled "Fulfilling the Promise—The National Wildlife Refuge System" (FWS 1999) was the culmination of a year-long process by teams of Service employees to evaluate the Refuge System nationwide. It was the focus of the first National Refuge System conference (in 1998), which was attended by refuge managers, other Service employees, and representatives from leading conservation organizations. The report contains 42 recommendations packaged with three vision statements dealing with wildlife and habitat, people, and leadership. The outcome of that effort continues to influence CCP planning both nationally and locally.

In 2010, we began updating our earlier vision for the Refuge System in a report titled “Conserving our Future” to chart a course for the Refuge System’s next ten years. (FWS 2011a). The new vision recognizes many new challenges in landscape conservation efforts, including a rapidly changing landscape and a tighter Federal budget. There is less undeveloped land, there are more invasive species, and we are experiencing the effects of a changing climate. In the face of these and other challenges, we believe that we can gain conservation strength through continued building of partnerships with Federal, State, and local agencies; tribes; nongovernmental organizations; Friends groups; and volunteers. As we have in the past, we strive to be a vital part of local communities as we work to conserve wildlife and habitats (FWS 2011a).

1.4 Other National Conservation Efforts

As part of our strategic habitat conservation mission, the refuge complex collaborates with the planning and conservation work of many regional and national agencies and organizations. Some of these projects are listed below.

Recovery Plans for Threatened and Endangered Species

Where federally listed threatened or endangered species occur within the refuge complex, we adhere to the management goals and strategies in the recovery plans. The list of threatened and endangered species at the refuge complex changes as species are listed or delisted or as listed species are discovered on refuge lands. Currently, the refuge complex follows the recovery and management plans for southwestern willow flycatcher, which is listed as an endangered species. (Refer to the habitat and wildlife resources section in chapter 3 and the biological resources section in chapter 4.) Other listed species or species of concern that could occur within the refuge complex are detailed in chapter 4, section 4.3.

Bird Conservation

Over the past few decades, there has been growing interest in conserving birds and their habitats. This has led to the development of partnership-based bird conservation initiatives that have produced international, national, and regional conservation plans. The North American Bird Conservation Initiative Committee was started in 1999. This coalition of government agencies, private organizations, and bird initiative groups in the United States, Canada, and Mexico is working to advance and integrate bird conservation efforts. The primary conservation planning initiatives follow the Partners in Flight North American Landbird Conservation Plan, the North American Waterfowl Management Plan, the U.S. Shorebird Conservation Plan, and the North American Waterbird Conservation Plan. The refuge’s role is described below for the Partners in Flight plan and the North American Waterfowl Management Plan.

Partners in Flight

The Partners in Flight program began in 1990 in response to the declining population levels of many migratory bird species. The program’s primary goal is to provide for the long-term health of birdlife in the Western Hemisphere. Priorities include the following: (1) prevent the rarest species from going extinct, (2) prevent uncommon species from becoming threatened, and (3) “keep common birds common” (Partners in Flight 2010).

For planning purposes, Partners in Flight splits North America into 37 conservation regions (see fig-

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Waterfowl hunting is a popular activity on Alamosa and Monte Vista Refuges during the fall.

ure 3). The refuge complex lies within Bird Conservation Region 16–Southern Rockies (North American Bird Conservation Initiative 2013). Region 16 is a topographically complex region which includes the Southern Rocky Mountains. Wetlands in the San Luis Valley support one of the highest densities of nesting waterfowl in North America, and these wetlands and the surrounding uplands provide migration habitat for sandhill cranes and other species.

Focal birds are a subset of the list of the Service's 2009 Birds of Management Concern (FWS 2011e) and are chosen based on: (1) high conservation need, (2) representative of a broader group of species sharing the same or similar conservation needs, (3) high level of current Service effort, (4) potential to stimulate partnerships, and (5) high likelihood that factors affecting status can realistically be addressed.

As discussed in chapter 3, section 3.2, and chapter 4, section 4.2, some of the Bird Conservation Region 16 focal species are found on the refuge complex.

North American Waterfowl Management Plan

By the mid-1980s, waterfowl populations had plummeted to record lows. In the United States, the habitat that waterfowl depend on for survival was disappearing at a rate of 60 acres per hour, with similar wetland losses occurring across Canada (FWS 2013).

Recognizing the importance of waterfowl and wetlands to North Americans and the need for international cooperation to help recover a shared resource, the United States and Canadian Governments developed the North American Waterfowl Management Plan to restore waterfowl populations through habitat protection, restoration, and enhancement. The plan was expanded to include Mexico in 1994. The plan is innovative not only because of its international scope but because of its implementation at the regional level (DOI, SEMARNAP Mexico, Environment Canada 1998).

The success of the waterfowl management plan depends on the strength of partnerships called joint ventures, which involve Federal, State, provincial, tribal, and local governments; businesses; conservation organizations; and individual citizens. Joint ventures are regional, self-directed partnerships that carry out science-based conservation through community participation. Joint ventures develop implementation plans that focus on the areas of concern identified in the plan. The refuge complex is part of the Intermountain West Joint Venture (FWS 2013h).

State Comprehensive Fish and Wildlife Conservation Strategy

Over the past several decades, there have been many documented declines of wildlife populations across the Nation. To try to keep species from becoming threatened or endangered, Congress created the State Wildlife Grant program in 2001. This program provides States and territories with Federal money to support wildlife conservation.

Under this program, each State develops a Comprehensive Fish and Wildlife Conservation strategy that defines an integrated approach to the stewardship of all wildlife species, with emphasis on species of concern and habitats at risk. The goal is to shift focus from single-species management and highly specific individual efforts to a landscape-oriented, geographically based conservation effort. The Service approves each State's conservation strategy and administers the State Wildlife Grant money.

Colorado's highest priority watersheds include the Rio Grande headwaters basin and the Upper Rio Grande basin, where the three national wildlife refuges are located, as well as the Sangre de Cristo Conservation Area (FWS 2012b) and the proposed San Luis Valley Conservation Area (FWS 2012a). Tier 1 species (highest priority) include allfederally listed species, along with 52 species of greatest conservation need, for 107 Tier 1 species. Tier 2 has the remaining 103 species of greatest conservation need. Tier 1 bird species relevant to the refuge complex include American bittern, Brewer's sparrow, long-billed curlew, the endangered southwestern willow flycatcher, and white-faced ibis. Fish include Rio Grande sucker, Rio Grande chub, and Rio Grande cutthroat trout.

The planning team for the CCP used Colorado's Comprehensive Fish and Wildlife Conservation Strategy during the development of the draft CCP and EIS (CDOW 2006). Implementation of the CCP's habitat goals and objectives will support the goals and objectives of the State conservation strategy.

1.5 Planning Process

Planning for the refuge complex's CCP began in fall 2010 with the establishment of a core planning team of Service staff from the refuge complex and the Mountain-Prairie region. Appendix B lists the planning team members, cooperating agency members, contributors, and consultants for this planning process.

The core team was responsible for the analysis, writing, and production of the draft CCP and EIS. With the entire refuge staff, the core team developed a preliminary vision and set goals for the refuge. The cooperating agencies (refer to section 1.6) are part of the larger planning team, which met throughout the process to develop and review the alternatives and to review drafts of the CCP and EIS.

While developing the CCP, the planning team collected available information about the resources of the refuge and surrounding area. This information is summarized in chapter 4 and served as the baseline for analyzing the predicted effects of the alternatives. Table 1 lists many other planning activities that occurred.

Table 1. Planning process summary for the CCP and EIS for San Luis Valley Refuge Complex, Colorado.

Date	*Planning activity*	*Outcome*
August 2010	Initial site meeting	Met with refuge staff. Identification of the refuge purposes and initial list of issues and qualities. Development of the CCP overview.
November 29, 2010	Kickoff meeting and workshop for vision and goals	Updated the list of issues and qualities affecting the refuge complex. Identification of needed biological information and maps. Development of draft vision and goals.
December 9, 2010	Scoping	Notification and briefing about the CCP development to the State of Colorado, Native American tribes, agencies, county commissioners, and others.
January 21, 2011	Public involvement summary	Report of the planned public involvement process for use as a handout and posting to the CCP web page.
February 01, 2011	Planning team kickoff	Initial meeting with refuge staff and the planning team.
March 15, 2011	Notice of intent in the *Federal Register*	Notice of intent to develop a CCP and EIS for the refuge complex and a request for comments published in the Federal Register (scoping comments accepted until April 29, 2011).
March 2011	Planning update 1	Announcement of dates, location, and format of public meetings and description of the draft vision and goals. Distribution to the mailing list and posting to the CCP web page.
March 29-31, 2011	Public scoping meetings	Information presented about the CCP development with question and answer and comment session.
March 2011	Public scoping meetings	Briefings with six adjacent counties on CCP and LPP process.
June 2011	Scoping report	Documentation of public comments from the comment period and identification of significant issues. Posting to the CCP web page.
August 2011	Planning team meeting for draft alternatives	Initial development of draft alternative concepts with refuge staff.
September 20-22, 2011	Planning team meeting for cooperating agencies and FWS staff	Refinement of draft alternative concepts.
January 2012	Planning update 2	Summary of four alternatives and schedule for the alternative workshops. Distribution to the mailing list and posting to the CCP web page.
January 23-25, 2012	Public workshops for draft alternatives	Input about the draft alternatives from people in six communities.
June 19-21, 2012	Workshop for biological objectives and strategies	Development of biological objectives and strategies for each alternative.
November 13-15, 2012	Workshop for public use objectives and strategies	Development of public use objectives and strategies for each alternative.
2013	Internal draft CCP and EIS	Initial development of the draft CCP and EIS.
April 21-22, 2014	Internal review meeting	Internal review of draft CCP and EIS by planning team and cooperating agencies
Summer 2014	Publication of draft CCP and EIS	Public review and comment period begins.

The planning process is based on the Refuge System planning policy, which was issued in 2000 (FWS 2000c). The resulting requirements and guidance for refuge and district plans, including CCPs and step-down management plans, make sure that planning efforts comply with the Improvement Act. The planning policy sets out the steps of the CCP and environmental analysis process (figure 5).

1.6 Public Involvement

Public scoping began in March 2011 with the release of a public involvement summary and a planning update that described the CCP process and its anticipated schedule (FWS 2011h). We published a notice of intent to prepare a CCP and EIS in the Federal Register on March 15, 2011 (76 FR Doc. 2011-5924). Since then, we conducted six public meetings during the scoping and development of the alternatives; mailed two planning updates; posted information on the Web page for the CCP; and coordinated with Federal, State, and local agencies and Native American tribes. We also held three meetings on a draft land protection plan and environmental assessment for the San Luis Valley Conservation Area (spring 2012). The proposed conservation area was modified by splitting it into two separate parts: the Sangre de Cristo Conservation Area (FWS 2012b), which conserves the alpine and mountain areas of the Sangre de Cristo Range, and the proposed San Luis Valley Conservation Area.

An important consideration in the development of this plan—including the vision, goals, objectives, and strategies—is the opinions, perspectives, and values of all interested citizens, agencies, and organized groups. While there are no requirements to base management decisions on public opinion, the Service values and considers input from the public. As detailed in appendix C, the Service has consulted with Native American tribes and has actively involved Federal and State agencies, local governments, organizations, and private citizens throughout the process.

Figure 5. Steps in the comprehensive conservation planning process.

Cooperating Agencies

We sent letters of notification about the planning process, including an invitation to join the planning team, to several Federal and State agencies: Bureau of Land Management (BLM) and the USDA Forest Service (USFS) (both agencies are part of the San Juan Public Lands Center), Bureau of Reclamation (BOR), National Park Service (NPS), Natural Resources Conservation Service (NRCS), Colorado Parks and Wildlife, and the Colorado Division of Water Resources. These agencies are all participating as cooperating agencies.

The Service also met and briefed the six counties (Alamosa, Rio Grande, Saguache, Conejos, Costilla, and Mineral) within the San Luis Valley about the planning process, including our current proposal for the San Luis Valley Conservation Area. Part of this original proposal was later split into two segments, one of which resulted in the establishment of the Sangre de Cristo Conservation Area in 2012. The three national wildlife refuges (Monte Vista, Alamosa, and Baca) lie within Alamosa, Rio Grande, and Saguache Counties.

Native American Tribes

The Service sent letters of notification about the planning process, including an invitation to join the planning team, to the following tribes: Cochiti Pueblo, Pueblo of Santa Clara, Pueblo of Laguna, Pueblo of Zuni, Pueblo of Picuris, Pueblo of San Ildefonso, Pueblo of Acoma, Pueblo of Santa Ana, Pueblo of Taos, Pueblo of Jemez, Uintah and Ouray Ute Indian Tribe, Southern Ute Tribe, Ute Mountain Tribe, Jicarilla Apache Nation, Ohkay Owingeh, and Navajo Nation. The Service is continuing to reach out to and work with tribes who are interested in the planning process.

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The planning team included a variety of Federal and State team members who helped with developing the draft CCP and EIS.

1.7 Significant Issues to Address

Our scoping process for the draft CCP and EIS identified many qualities of the refuges along with issues and recommendations. Based on this information, as well as guidance from the Improvement Act, NEPA, and our planning policy, we identified seven significant issues to address:

- Habitat and wildlife management
- Water resources
- Landscape conservation and protection
- Visitor services
- Partnerships and operations
- Cultural resources and tribal coordination
- Research, science, and protection of the physical environment

Our planning team considered every comment that was received during the public scoping process. These comments were grouped into related topics and subtopics as described in the scoping report posted on the CCP Web page (FWS 2011h). Significant issues are those that are within our jurisdiction, which suggest different actions or alternatives, and that will influence our decision.

Habitat and Wildlife Management

We manage a wide variety of habitats on the refuges, including wet meadows, playa wetlands, riparian areas within the floodplain of the Rio Grande, desert shrublands, grasslands, and croplands. The approximately 106,000 acres on the refuges provide important nesting, migrating, and wintering habitat for many bird species. The federally endangered southwestern willow flycatcher, a small neotropical migrant, is found fairly frequently in the willow–cottonwood corridor along the Rio Grande in the Alamosa Refuge. Several other Federal and State species of concern, including the Rio Grande sucker, Rio Grande chub, and northern leopard frog, are found within or adjacent to the refuge. Many species of mammals use the refuge, including elk, deer, coyote, and porcupine.

Water in the refuge complex is actively managed to create habitat for migratory birds, including white-faced ibis, waterfowl, shorebirds, raptors, passerines, and the well-known populations of greater and lesser sandhill cranes. Some of these habitats may not be sustainable without a continued emphasis on water management. New State regulations require that all ground water users in the San Luis Valley replace depletions to streams resulting from their use of ground water. This "augmentation" of well use will affect refuge management.

Another concern is whether we should continue to provide barley, a nonnative crop that provides sandhill cranes and waterfowl with a high carbohydrate food source in a small area, but that also removes that land and associated water from the production of native vegetation. We are looking at the long-term sustainability of this supplemental feeding and whether increasing the restoration of native plant communities would result in unacceptable tradeoffs in these situations. Historic levels of naturally occurring food are not available for sandhill cranes during their spring migration. Not supplementing their diet with small grain, especially in the spring, could affect the health and vigor of the cranes. We will also address the role that we should play in the management of other migratory birds; endangered and threatened species; and species of concern found on the refuge complex.

The CCP and EIS addresses the issues associated with increasing the elk populations across all the refuges. On the Baca Refuge in particular, elk are having a significant effect on some resources, particularly riparian areas. They are inhibiting the ability of willows to grow, which is detrimental to habitat for riparian species. Also, adjacent landowners have expressed concerns about the effect that elk are having on their lands.

There has also been interest expressed in the reintroduction of the American bison on the Baca Refuge. Whether the Baca Refuge could support semi-free-ranging bison without negatively affecting other species is an issue of concern. The NPS at Great Sand Dunes National Park and Preserve is developing an ungulate management plan, and we are committed to sharing information and coordinating the two planning processes where possible.

Other issues to be addressed include the use of prescribed fire, livestock grazing, haying, farming, control of invasive species, wildland fire suppression, and management of diseases.

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Hunting, including the harvest of elk across the refuge complex, is a key topic of interest in the planning process.

Water Resources

The topic of water is one of the biggest concerns for residents in the San Luis Valley. There is not broad understanding of the refuge complex's portfolio of water rights and their decreed beneficial uses. Because water management is an important tool in providing food and habitat for birds, we commissioned a hydrogeomorphic analysis to look at historic water flows on the refuges. This information helped to inform alternatives development in the planning process.

The management and development of water resources must consider water rights, water quality, amount and timing of water use, the pumping of wells and the use of irrigation across the refuge complex, and the protection of wetlands including playas, riparian areas, wet meadows, and the river corridor.

Landscape Conservation and Wilderness Review

Many individuals, organizations, and agencies have been involved in protecting wetlands and other areas in the San Luis Valley. The refuge complex plays an important role in this conservation effort. The Department of the Interior and other Federal agencies are committed to working with the State, local stakeholders, private landowners, and other partners to help conserve healthy lands and waters and promote tourism in the San Luis Valley and the Rio Grande corridor.

As required by Service policy, we will also be looking at whether any areas within the refuge com-

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These young wildlife enthusiasts check out the wildlife on Monte Vista Refuge. There is interest in having more opportunities for wildlife observation and interpretation on the refuge complex.

plex would meet the values expressed in the Wilderness Act and the Service's Wilderness Stewardship Plan (USFWS 2008).

Visitor Services

Hunting, including harvest of elk on all the refuges, is a key topic of interest in the planning process. There is both support for and opposition to the use of hunting as a management tool and a wildlife-dependent recreational activity.

There is also a desire by many groups, including the Friends of the San Luis Valley National Wildlife Refuges (Friends group), to invest more in environmental education and interpretation to educate visitors about the importance of the refuges and the history of the valley. The Baca Refuge, for example, is closed to the public. The types of potential services and access, the socioeconomic effects, and how energy development could affect visitor aesthetics on the Baca Refuge are considered in the CCP. These activities also affect refuge staff, operations, and infrastructure needs.

Partnerships and Refuge Operations

Many agencies, organizations, and landowners are currently working in partnership to accomplish many of our common goals, and the CCP and EIS will provide for more opportunities to engage and collaborate with others. (Refer to chapter 3, section 3.17 for a list of our partners.) Wildlife populations are greatly affected by outside influences as well as conditions found within the refuges. Invasive species are a threat not only to the refuges, but to other Federal, State, and private landowners. Privately owned mineral rights, energy development on adjacent lands, fire management, and other rights of ways influence future conditions on the refuges. Although we do not own the mineral rights on the Baca Refuge, we recognize that we need better strategies on how to handle the third party mineral rights and their potential effects. The surface use agreements that come with the mineral rights limit how the refuge can manage potential effects. There is significant interest by many of our partners in thinking beyond the boundaries of each refuge to craft plans at the landscape scale whenever possible and to use a variety of mechanisms to accomplish our goals.

Refuge operations, particularly operational and infrastructure needs, are being considered. The Baca Refuge boundary has not been completely surveyed, posted, or fenced. The lack of boundary delineation results in trespassing and ownership conflicts. When the Baca Refuge was acquired, it came without any resources or money for operations, which has created challenges in managing the refuge complex. We also need to evaluate the operational demands (short-term and long-term) of the new Sangre de Cristo Conservation Area and the proposed San Luis Valley Conservation Area and find ways to sustain these easement programs. Throughout the refuge complex, there is a need to continually re-evaluate the allocation of staff, as current staff levels are not adequate to meet operational needs. For example, we had to greatly curtail our environmental education efforts because of lack of money for staff.

Increasing costs and the overall amount of energy used to pump needed water for Monte Vista Refuge raises the question of whether these activities are sustainable in the long term, particularly in light of the need to reduce energy use. A comprehensive condition assessment of infrastructure for water delivery and measurement is needed. Further, the upkeep of historic buildings on the refuges needs to be addressed.


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The historic Deadman camp corral on Baca Refuge.

Cultural Resources and Tribal Coordination

About 12,000 years of history and prehistory have been documented on the refuges. In general, there has been outstanding cooperation between Federal agencies, tribes, and collectors to preserve and document the known cultural resources in the region.

Only about 5 percent of the areas found on the refuges have been comprehensively inventoried. Concern exists that the lack of information could lead to the destruction of important sites. Lack of research, concerns about destruction and vandalism, lack of staff to maintain legal obligations for compliance, and our ongoing relationships with tribes, collectors, and other agencies are all important issues to be addressed in the CCP and EIS.

Research, Science, and Protection of the Physical Environment

The refuge complex exists in a unique area in terms of some of the protected environments and large, contiguous tracts of open land. Multiple agencies, the scientific community, a local university, a junior college, and some private citizens are all interested in protecting the values of the area. We believe there are many opportunities to work with others to achieve our research and science needs.

Baca Refuge is adjacent to designated and proposed wilderness and a class I air quality area. Other physical attributes include the immense dark night sky and quiet soundscapes. These were identified as important qualities by many residents in the surrounding community.

Climate change is one of the biggest issues affecting plants and wildlife today across our lands. In the San Luis Valley, current data suggest that climate change could be affecting the valley in ways such as increased temperatures (FWS 2010, BOR 2013b) and earlier snowmelts in the western United States (Karl et al. 2009). On adjacent forest lands, there have been dramatic changes in forest vegetation because of large areas of diseased trees which could lead to changes in water flow. Longer periods of drought may become more common. These changes could threaten many species in the valley and on the refuges, particularly those species that depend on wetland, riparian, and open water habitats. Even if the refuges enhance habitat through water manipulation, sandhill cranes, waterfowl and other migratory birds may suffer because of conditions in other parts of the valley. Strategies for managing the refuges in light of climate change, a declining aquifer, energy development, wildlife diseases, and invasive species are important issues to address in the planning process.

1.8 Issues Not Addressed

We considered several issues that were identified by the public during scoping and alternative development but that were not selected for detailed analysis in the CCP and EIS. In accordance with requirements of NEPA, we have identified and eliminated from detailed analysis the topics or issues that are not significant or are out of the scope of this planning process. These issues and the rationale for not discussing them further in the CCP and EIS are briefly described below.

Development of Mineral Rights

The United States does not own the mineral rights within large portions of the Baca Refuge. The draft CCP and EIS does not address the rights of private property owners to exercise their rights to extract any locatable minerals or oil and gas within or adjacent to the refuge. Any exploration or other activities supporting the testing, development, or production of gas, oil, and other resources would be analyzed through an additional and separate NEPA process designed to address that issue specifically. While this CCP does not analyze any future mineral development alternative, we are looking at how habitat, wildlife, and visitor services should be managed if private mineral development occurs on the Baca Refuge.

Baca Oil and Gas Environmental Assessment

Lexam VG Gold, Inc., an owner of a mineral interest below parts of the surface estate of the Baca Refuge, has proposed drilling two wells to explore for oil and gas on the refuge. Following the development of an environmental assessment in January 2011 in which several stipulations were developed to protect the resources of the refuge and minimize the effects on the surface estate of Baca Refuge, we issued a finding of no significant impact for the proposal by Lexam. The CCP and EIS does not readdress the decision made on April 1, 2011, for two test wells (FWS 2011b). Any more exploration wells or activities supporting the production of natural gas or oil on the refuge would be analyzed through an additional and separate NEPA process.

Closed Basin Project

The closed basin is a hydrological basin with no surface outlet that encompasses most of the northern half of the San Luis Valley floor. BOR runs the San Luis Valley Closed Basin Project which collects and diverts unconfined ground water and available surface flows within the closed basin that would otherwise be lost to evapotranspiration (BOR 2013a). Parts of the Closed Basin Project are within Alamosa and Baca National Wildlife Refuges. The CCP and EIS does not address any jurisdictional, operational, or infrastructure issues related to this project. The legislation authorizing Baca Refuge specifically states that infrastructure used in the operation, maintenance, repair, and replacement of any features associated with the project are not affected by the Great Sand Dunes National Park and Preserve Act of 2000.

Refuge Revenue-Sharing Payments

Since 1935, we have made revenue-sharing payments for refuge land under our administration to counties under the Refuge Revenue Sharing Act of 1935 (16 U.S.C. 715s), which was subsequently amended. These payments are not the same as other Federal revenue-sharing payments measures such as Payments in Lieu of Taxes, which applies to lands administered by other agencies including those within the Department of the Interior. When there is not enough money to cover the payments, Congress is authorized to appropriate money to make up the deficit; however, payments to a county are reduced when Congress fails to appropriate the money. Understandably, these are issues of concern for many counties in times of declining revenues, but the Service has no control over Congress in making these payments. This issue is outside the scope of the draft CCP and EIS.

Military Overflights

The United States Air Force prepared a draft environmental assessment to evaluate the potential environmental consequences of establishing a Low Altitude Tactical Navigation Area in northern New Mexico and southern Colorado (USAF 2011). The navigation area would provide airspace to C-130 and CV-22 aircraft for training purposes. The Federal Aviation Administration has the responsibility to plan, manage, and control the structure and use of all airspace over the United States. Day-to-day airspace designation, design, and management are delegated through the Federal Aviation Administration to the military.

The Improvement Act specifically exempted overflights above a refuge from compatibility requirements (FWS 2000a). Except for any cumulative effects that would occur as the result of our proposed actions, the CCP and EIS does not address whether military overflights could occur over the refuge complex, as these issues are outside the scope of the analysis.

Water Rights and Water Use Off the Refuge Complex

As described under section 1.7 above, the topic of water management and use is a concern for everyone in the San Luis Valley. In this CCP and EIS, we have provided information about how the hydrology of the water systems affects our management of the refuges, including a discussion of our water rights, and our use of water for accomplishing our habitat and wildlife purposes and for providing compatible wildlife-dependent recreation. We manage our water resources to achieve our refuge objectives based onthe overall availability of water resources and within the restrictions dictated by the legal decrees, authorizing legislation, and existing leases. Except for any cumulative effects that are directly related to the actions identified in the alternatives (refer to chapter 3), any discussion of water rights or the public's use of water off the refuge complex is outside the scope of the analysis. While we recognize the importance of these issues, the management and use of refuge water resources off the refuge complex is not subject to Service policy. (Refer to section 1.9 below.)

1.9 Scope of the Document

The scope of our decisions and analysis are broken out into two areas, decision area and analysis area.

Decision Area

The decision area is the area within the designated boundaries of Monte Vista National Wildlife Refuge, Alamosa National Wildlife Refuge, and Baca National Wildlife Refuge (figure 6; refer to chapter 2 for a complete description of the refuge complex).

Analysis Area

The analysis area (figure 6) has the decision areas as well as areas outside the decision areas where most of the direct, indirect, or cumulative effects could occur as a result of implementing the actions found in the alternatives. These effects are described in chapter 4 and chapter 5. The foreseeable activities in which our actions in combination with other activities could result in cumulative effects are described in detail in chapter 3, section 3.9.

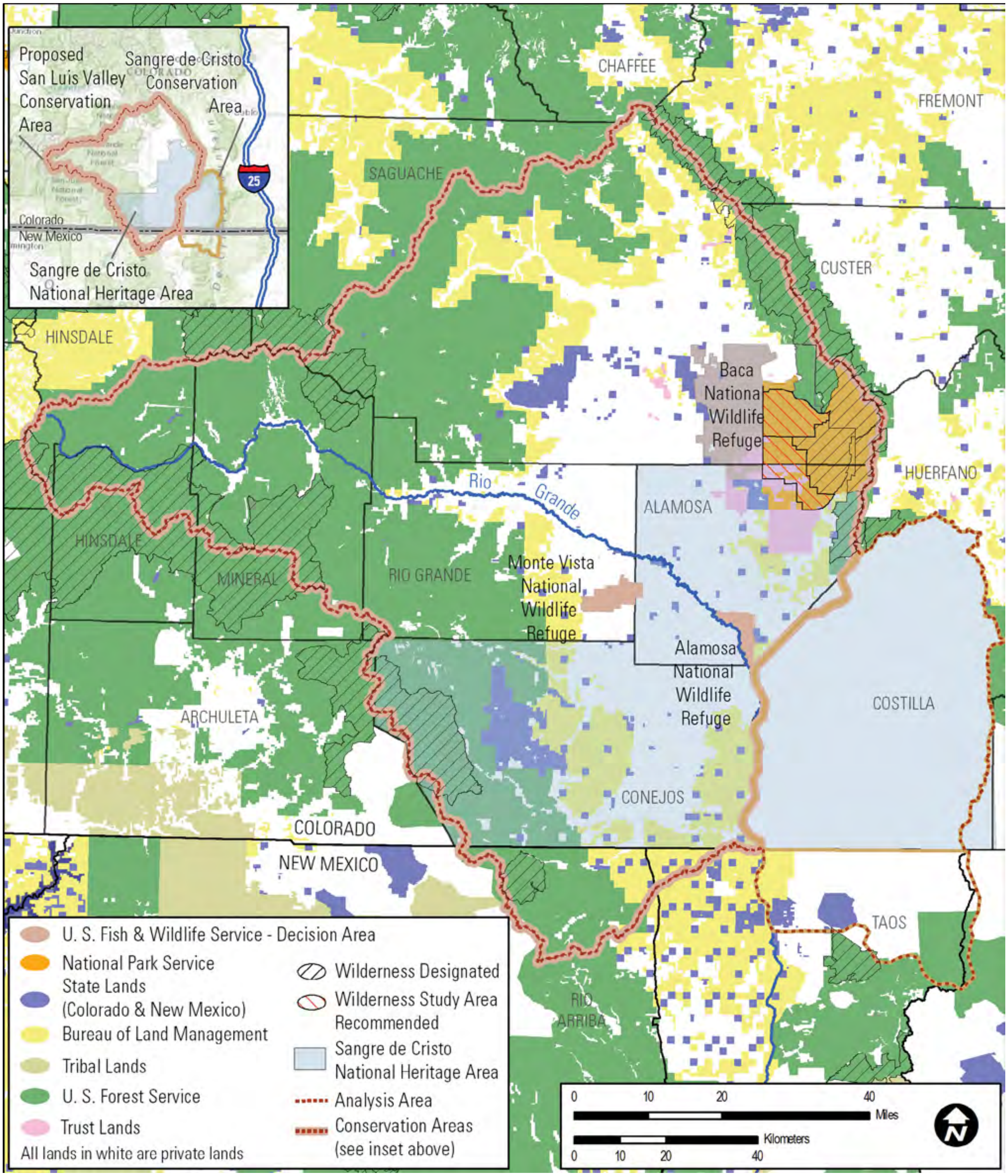

Figure 6. Analysis and decision areas for the CCP and environmental analysis.

Chapter 2—The Refuge Complex

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An afternoon storm passes over the Baca Refuge and the Sangre de Cristo mountains. About 60 percent of the refuge's precipitation occurs as rain in July and August.

This chapter explains the management history, purpose, and special values of the refuge complex, as well as the development of the vision and goals for the CCP planning process. The headquarters for the three refuges is located in Alamosa, Colorado. Figures 7, 8, and 9 illustrate the base map and elevation of the three refuges.

As an integral part of the CCP and EIS process, in 2013, we undertook a study of the history of the hydrologic, physical, and biological processes affecting the three refuges (Heitmeyer et al. 2013a,b,c). During the study, called the hydrogeomorphic methodology evaluation (HGM) (Heitmeyer et al. 2013a,b,c), we interpreted the historical and current information about 1) geology and geomorphology, 2) soils, 3) topography and elevation, 4) hydrology, 5) aerial photographs and maps, 6) land cover and plant and animal communities, and 7) physical anthropogenic features (relating to the influence of human beings on nature) of the ecosystems of the refuge complex. The HGM study provided us with a better understanding of the hydrological history of the refuge complex, in addition to the physical and biological formations, features, and ecological processes of the three refuges and the surrounding region.

Every refuge in the Refuge System has a purpose for which it was established. This purpose is the foundation on which all refuge programs are built, from biology and public use to maintenance and facilities. Refuge purposes are found in the legislative acts or administrative orders that authorize either the transfer or acquisition of land for a refuge. An individual refuge may contain lands that have been acquired under a variety of transfer and acquisition authorities, giving a refuge more than one purpose. Table 2 lists the significant land authorizations for the refuge complex. The goals, strategies, and objectives in the draft CCP and EIS are intended to support the purposes for which the refuges were established. (Refer to chapter 3, section 3.8.)

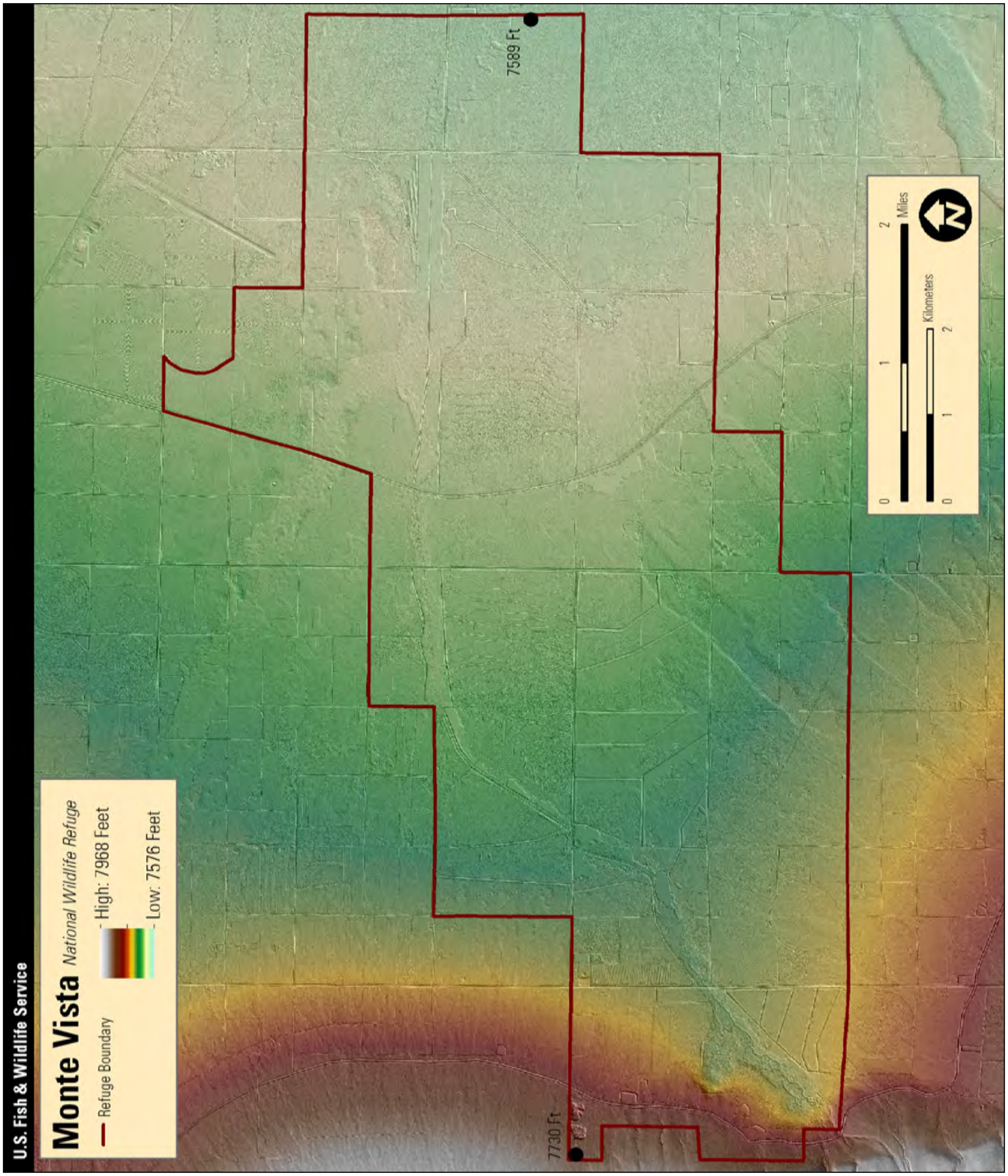

Figure 7. Base map and elevation for Monte Vista National Wildlife Refuge, Colorado.

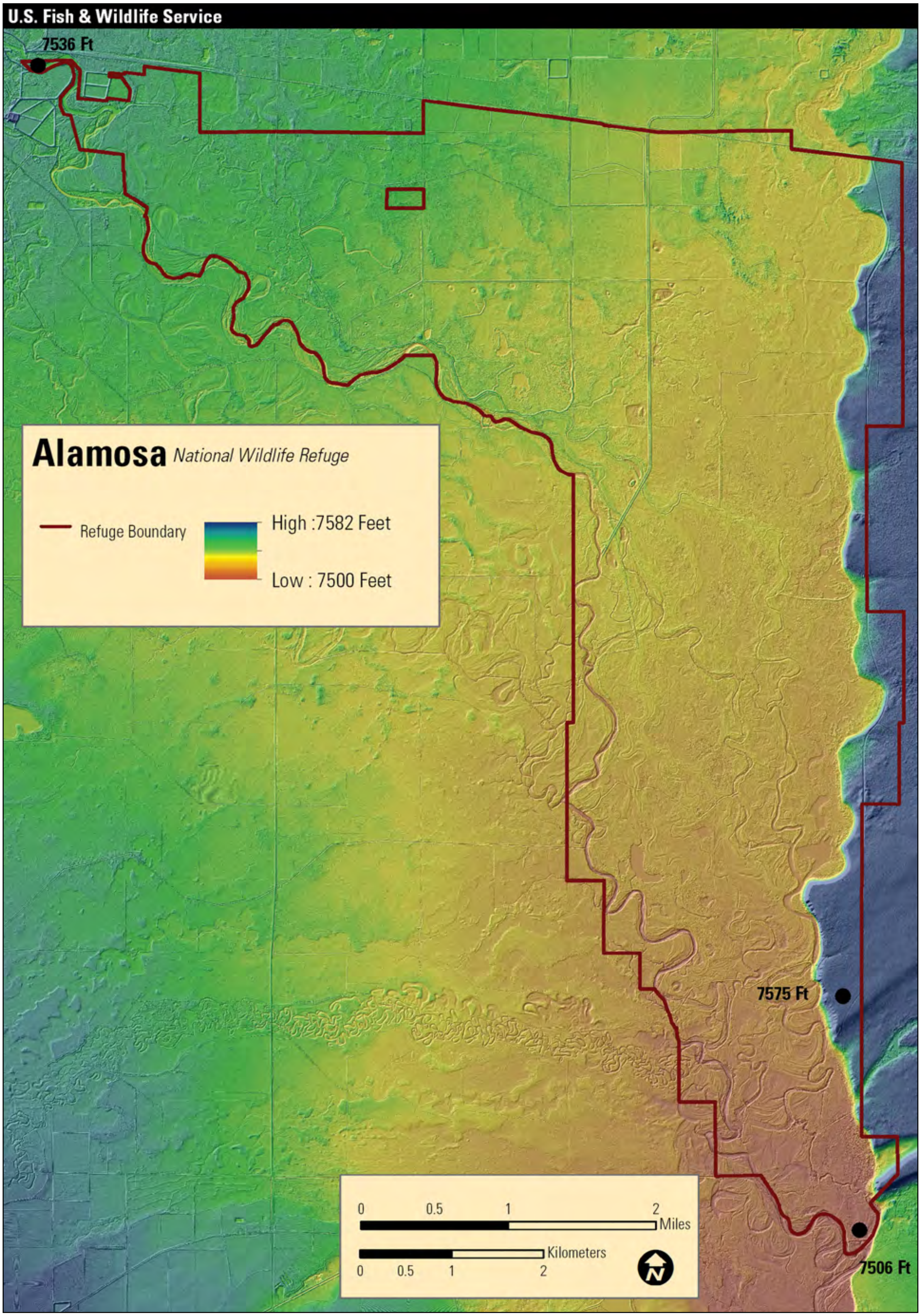

Figure 8. Base map and elevation for Alamosa National Wildlife Refuge, Colorado.

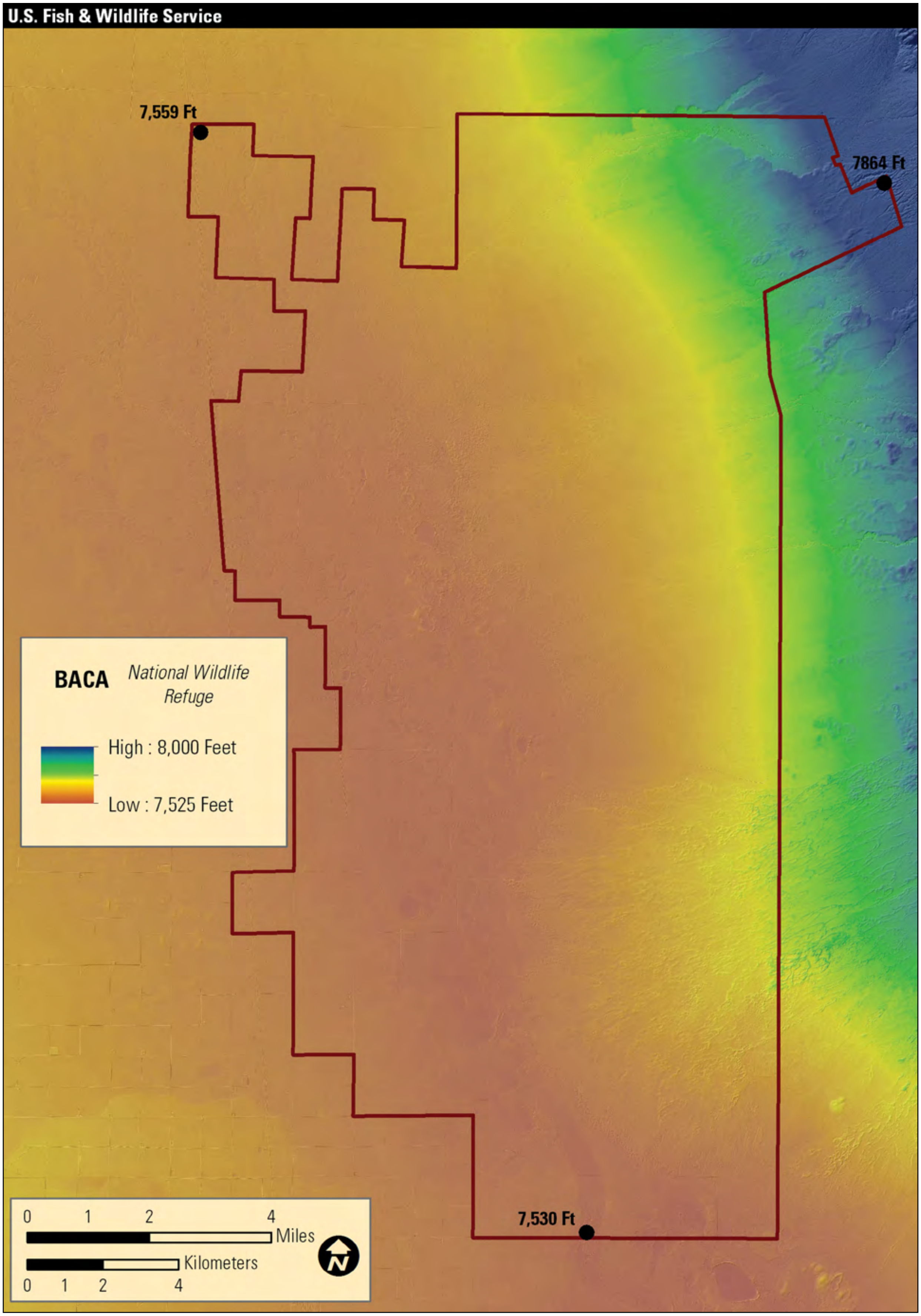

Figure 9. Base map and elevation for Baca National Wildlife Refuge, Colorado.

Table 2. History of significant land authorizations for the San Luis Valley National Wildlife Refuge Complex, Colorado.

Date	Authority	Number	Subject
May 26, 1952	Executive Order	10355	Delegated to the Secretary of Interior the authority of the President to withdraw or reserve lands of the United States for public purposes; supersedes EO 9337 (1943) and amended by EO 12608 (1987); pursuant to Public Law 248, 82nd Congress
Monte Vista National Wildlife Refuge			
June 10, 1952	Migratory Bird Conservation Act	45 Stat. 1222	Date approved by Migratory Bird Conservation Commission according to procedure; 3 tracts totaling 2,247 acres (first tract acquired 09/03/1952)
September 22, 1960	Public Land Order	2204	Withdrawal of 800 acres pursuant to EO 10355; 60FR9141
Alamosa National Wildlife Refuge			
June 27, 1962	Migratory Bird Conservation Act		Date approved by Migratory Bird Conservation Commission; same meeting enlarged Monte Vista National Wildlife Refuge (see above)
December 1, 1965	Public Land Order	3899	Withdrawal of 86 acres for Alamosa Refuge
May 18, 1965	Migratory Bird Conservation Act		Enlargement of refuge to 10,291 acres by Migratory Bird Conservation Commission
October 20, 1972	Public Law 92-514		Bureau of Reclamation Project Authorization Act of 1972 (Closed Basin Project); allowed for furnishing water for operation of Alamosa Refuge
Baca National Wildlife Refuge			
November 22, 2000	Public Law 106-530	114 Stat. 2527	Provision to establish the Great Sand Dunes National Park and Preserve and Baca National Wildlife Refuge (Cited as Great Sand Dunes National Park and Preserve Act of 2000)
April 8, 2003	Federal Register	68 FR11579	First acquisition of 3,315 acre White Ranch property transferred from BOR as part of settlement agreement
May 2005			Conceptual management plan for Baca National Wildlife Refuge
August 10, 2005	Public Land Order	7641	Transferred administrative jurisdiction of about 1,179 acres, including surface and mineral estate and 3,991 acres of reserved Federal mineral estate
March 11, 2009	Public Law 111-8		Omnibus Appropriations Act amended Great Sand Dunes National Park and Preserve Act of 2000 to provide refuge purposes for Baca National Wildlife Refuge
March 20, 2013	NEPA document		Final interim elk management plan and environmental assessment for San Luis Valley National Wildlife Refuge Complex
Sangre de Cristo Conservation Area			
August 1, 2012	NEPA document		Finding of no significant impact signed by the Director of the Fish and Wildlife Service
September 14, 2012	Federal Register	77FR 67830	Establishment of the Sangre de Cristo Conservation Area through donation

2.1 Establishment, Acquisition, and Management History

Monte Vista and Alamosa National Wildlife Refuges are discussed first, followed by Baca National Wildlife Refuge and the Sangre de Cristo Conservation Area.

Monte Vista and Alamosa National Wildlife Refuges

Monte Vista and Alamosa Refuges were set aside under the same authority and consequently have identical purposes. They were established under the authority of the 1929 Migratory Bird Conservation Act (45 Stat. 1222; 16 U.S.C. §715d) "…for use as inviolate sanctuaries, or for any other management purposes, for migratory birds."

Monte Vista National Wildlife Refuge

The Monte Vista National Wildlife Refuge (Monte Vista Refuge) was established in 1952 as the first national wildlife refuge in Colorado, although plans to purchase this area were considered as far back as 1941 (FWS 1994). Although the refuge was originally going to be named the Spring Creek National Wildlife Refuge, officials felt that Spring Creek was too common a name, so the refuge was named after the nearby town of Monte Vista. On November 1, 1949, the proposed refuge was considered and approved by the Colorado Game and Fish Commission (MBCC 1952). Due to a delay in reaching a price agreement for the purchase of tracts for the proposed refuge, it was not approved by the Migratory Bird Conservation Commission until June 10, 1952 (MBCC 1952). The funding for three tracts was obligated in fiscal year 1952, with the first one obligated on September 3, 1952 (FWS 1994). The Bureau of Land Management withdrew 800 acres administered by the agency on September 19, 1960 (Public Land Order 2204 and 25 FR9141) from all forms of appropriation under public land laws, including mineral laws (Title 30, U.S.C., and chapter 2). In 1962, the Migratory Bird Conservation Commission authorized additional acreage to bring the total to 12,402 acres. Today, the acreage of Monte Vista Refuge is about 14,834 acres, of which 13,951 acres have been purchased by the Service (FWS 2013a) (figure 7).

Alamosa National Wildlife Refuge

The Migratory Bird Conservation Commission approved the establishment of Alamosa Refuge on June 27, 1962 (MBCC1962). It was officially established on July 25, 1963, with the signing of the deed for the first parcel. The Colorado Game, Fish and Parks Commission approved Alamosa Refuge on May 4, 1962. On December 1, 1965, about 86 acres administered by BLM were withdrawn from the public domain through Public Land Order 3899 (30FR15098). In 1965, the approved acreage was enlarged to about 10,291 acres (FWS 1969). The acquisition of several other parcels, such as the former Lillpop property, brought Alamosa Refuge to its current area of about 12,026 acres (FWS 2013a). Of this, 816 acres were acquired by another Federal agency, 10,905 acres were purchased by the Service, and 219 acres were donated (FWS 2013a) (figure 8).

Refuge Management History for Monte Vista and Alamosa National Wildlife Refuges

We completed a CCP for Monte Vista and Alamosa Refuges in 2003 that identified habitat and public use goals (FWS 2003). Since that time, we have sought to implement these goals, recognizing the water availability and quality constraints and the need for a different approach to designing and implementing future restoration and management efforts. This draft CCP and EIS builds on past management.

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A wetland area on Alamosa Refuge in winter.

Figure 10. Aerial photograph of Monte Vista National Wildlife Refuge, Colorado, in 1941.

For over 100 years, the San Luis Valley has been irrigated to produce hay, small grains (wheat and barley), and vegetables (potatoes, peas, and lettuce). About 30 percent of the San Luis Valley is currently irrigated with surface water from the Rio Grande, Conejos River, and numerous smaller drainages, as well as pumped well water. The construction of over 2,000 miles of ditches and the pumping of ground water for irrigation has likely diminished the quality and quantity of many naturally occurring wetland areas while establishing new artificial wetlands. The wetlands originally associated with the creek and river systems in the San Luis Valley have been diminished by irrigation diversions by agricultural and wildlife managers (FWS 2003). However, irrigation practices have also resulted in the creation of thousands of acres of wet meadow habitats. These shallowly flooded, native plant meadows are usually hayed and grazed every year but still provide foraging habitat and some nesting habitat for migratory birds.

Some of the information about the landscape of the refuge complex prior to Euro-American settlement was taken from descriptions provided by the first refuge manager (P. Bryant); settlers from the early 1900s (communication obtained from refuge files); the original refuge master plan (USFWS 1962); the maps produced by the 1874, 1875, and 1877 Wheeler expeditions; and the Rio Grande County Soil Survey.

The area that became Monte Vista Refuge (figure 10) was largely devoid of palustrine emergent wetlands (wetlands permanently or semipermanently flooded). When these wetlands did occur, they were in the floodplains of Spring Creek, Rock Creek, and possibly Cat Creek. The natural flows in these creeks have been drastically reduced in the last 50 to 150 years and, in the case of Spring Creek, eliminated completely due to extensive ground water withdrawal. Therefore, the availability of naturally occurring palustrine emergent wetlands on the Monte Vista Refuge has been reduced. Wetlands with saturated soils, perennial wetland vegetation, and intermittent or temporary flooding may have been present, but they were probably dependent on ground water levels that were higher than current levels. The dominant plant community is believed to have been desert salt shrubland primarily consisting of rabbitbrush, greasewood, saltgrass, and alkali sacaton (Rocchio et al. 2000).

Between 1882 and the time the Monte Vista Refuge was established (1952), much of the shrubland habitat was converted to wet meadows for livestock grazing and the production of hay and croplands via irrigation by private landowners. After the refuge was established, the development of water management facilities to emphasize wildlife habitat production on these irrigated lands began. Low levees were built throughout the refuge to maintain irrigation of the shallow water wetland vegetation and compensate, in part, for the loss of wetland habitat throughout the San Luis Valley. These wetlands completely rely on the delivery of surface water and pumped well water through a series of canals, ditches, and borrow areas.

The Alamosa Refuge lies in the Rio Grande floodplain and is part of what was referred to as the Alamosa Marshes, which was one of the largest wetland complexes in the San Luis Valley, as documented in the 1878 Wheeler expedition maps (U.S. Army Corps of Engineers 1878). By the late 1800s, the area that is now the refuge was managed for cattle grazing, and several irrigation ditches were established to irrigate meadows for the production of livestock forage.

After this land was converted to a national wildlife refuge in 1962, similar irrigation practices were continued. These combined irrigation practices have probably resulted in water being kept longer in some wetlands than was the case historically (see figure 11). Other changes in refuge habitat are the result of modifications to the hydrology of the Rio Grande; for example, it is speculated that flooding on the Alamosa Refuge occurred more frequently and covered most of what is now the refuge. Although natural flood water was no longer supplied by the Rio Grande, relatively few wetland impoundments were artificially created because oxbow and other wetland depressions still existed. Few improvements were made in the original water management infrastructure used by cattle ranchers, and water is still moved through this system to irrigate wetland vegetation throughout the refuge.

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A wetland on the Monte Vista Refuge.

Past Lawsuit

In 1992, Monte Vista Refuge was included in the nation-wide compatibility lawsuit *National Audubon Society et al.* v. *Bruce Babbitt et al.* alleging that the Service had violated the National Wildlife Refuge Administration Act, the Refuge Recreation Act, NEPA, and the Administrative Procedures Act by allowing incompatible uses in the Refuge System. (Refer to chapter 1, section 1.2.) Monte Vista Refuge was included because of its heavy reliance on livestock grazing in managing habitat. The Service settled the lawsuit with the plaintiffs out of court in October 1993 (59FR29289). The settlement agreement as it specifically related to Monte Vista Refuge required the Service to take six specific actions which were subsequently met (FWS 2003).

During the 1990s and early 2000s, this lawsuit and the resulting settlement had a substantial influence on the day-to-day operations of both refuges. As part of the settlement agreement, livestock grazing on the refuge complex was curtailed while a 5-year research study was conducted to evaluate various habitat management tools including livestock grazing. Dr. Leigh Fredrickson, a wetland ecologist from the University of Missouri, was selected to conduct the research, which began on both refuges in 1996. In recent years, the refuge complex has initiated a compatible, prescribed livestock grazing program to reduce decadent vegetation and pervasive weeds. Prescribed fire is also used when possible, but with many restrictions in place regarding the use of fire combined with limited staff resources, the refuge complex has not been able to achieve all of its habitat management objectives through prescribed fire alone.

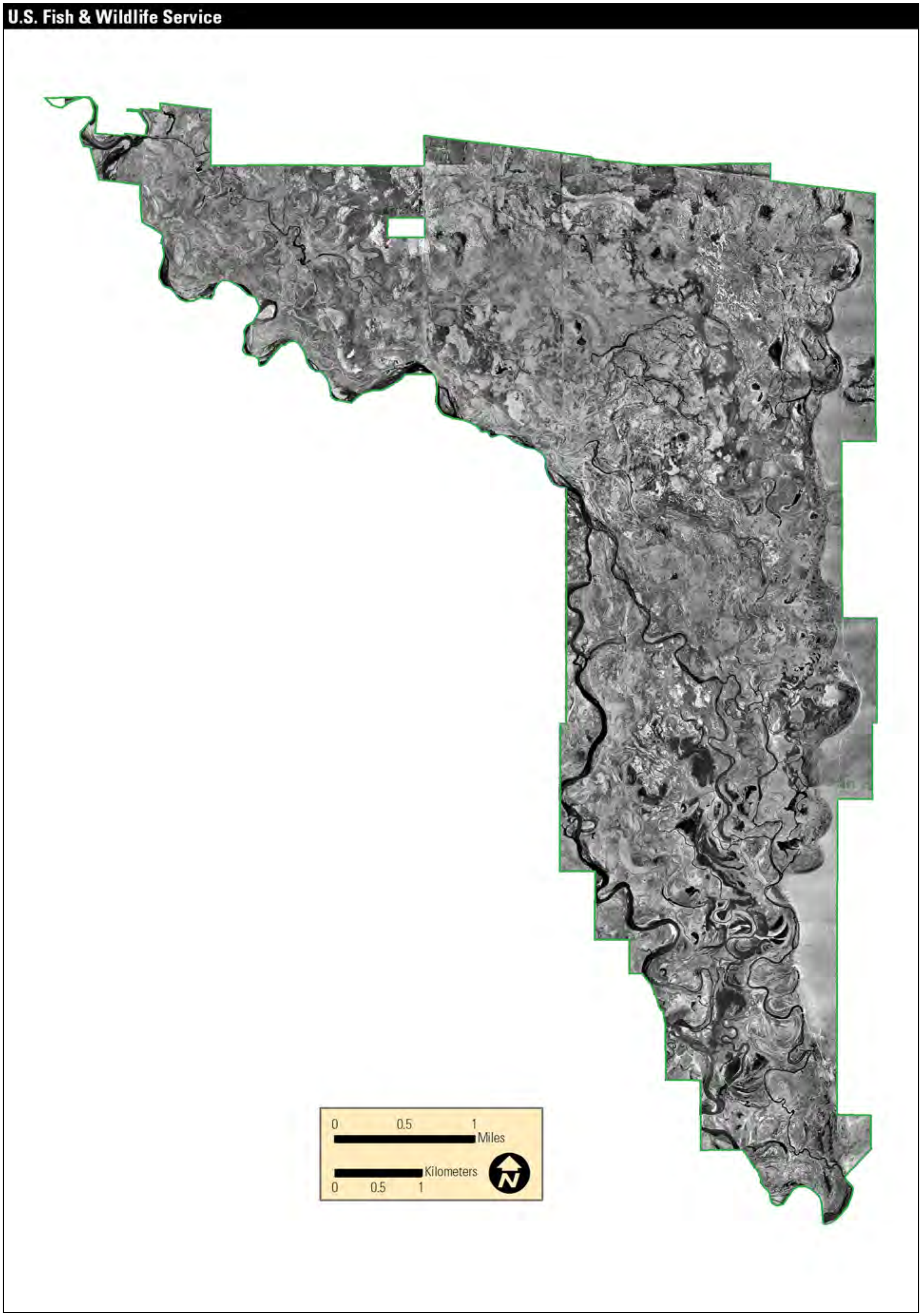

Figure 11. Aerial photograph of Alamosa National Wildlife Refuge, Colorado, in 1941.

Baca National Wildlife Refuge

Before the establishment of the Baca Refuge, the property was a private cattle ranch for more than 100 years (figure 12 shows an aerial photograph of the land in 1941). The Baca Refuge was authorized by Public Law 106-530 on November 22, 2000, as part of the Great Sand Dunes National Park and Preserve Act of 2000. The authorized refuge boundary is about 92,500 acres and is located in Saguache and Alamosa counties. In addition to authorizing the establishment of Baca Refuge, the act recognized the significant diversity of resources within the Great Sand Dunes ecosystem and elevated the former national monument to a national park. Section 6 of the act established Baca National Wildlife Refuge under the authority of the National Wildlife Refuge System Administration Act as amended by the Improvement Act. It also called for the protection of water resources, requiring the Secretary of Interior to "(1) protect and maintain irrigation water rights necessary for the protection of monument, park, preserve, and refuge resources and uses; and (2) minimize to the extent consistent with the protection of national wildlife refuge resources, adverse impacts on other water users." The legislation, which received widespread support, focused not only on protecting the region's hydrology, which the unique sand dunes ecosystem depends on, but also on protecting the exceptional ecological, cultural, and wildlife resources of the area (FWS 2005).

In May 2005, the Service finalized a conceptual management plan (CMP) to serve as a guide for managing Baca Refuge until a comprehensive conservation plan could be developed. Interim goals include 1) evaluating pre-acquisition management strategies in relation to wetland, upland, and riparian habitats; 2) assembling resource information; 3) assembling visitor services information and needs; 4) assembling operational and funding needs; 5) maintaining and evaluating pre-acquisition irrigation strategies; and 6) ensuring law enforcement protection. Since passage of the authorizing legislation for Baca Refuge, there has been little additional funding for managing the refuge complex so staffing has been limited. As discussed in chapter 1, section 1.2, all refuges are closed to public use until they are officially opened (FWS 2005).

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A wet meadow on the Baca Refuge. The 92,000-acre refuge boundary was authorized in 2000, and the first unit was acquired in 2003.

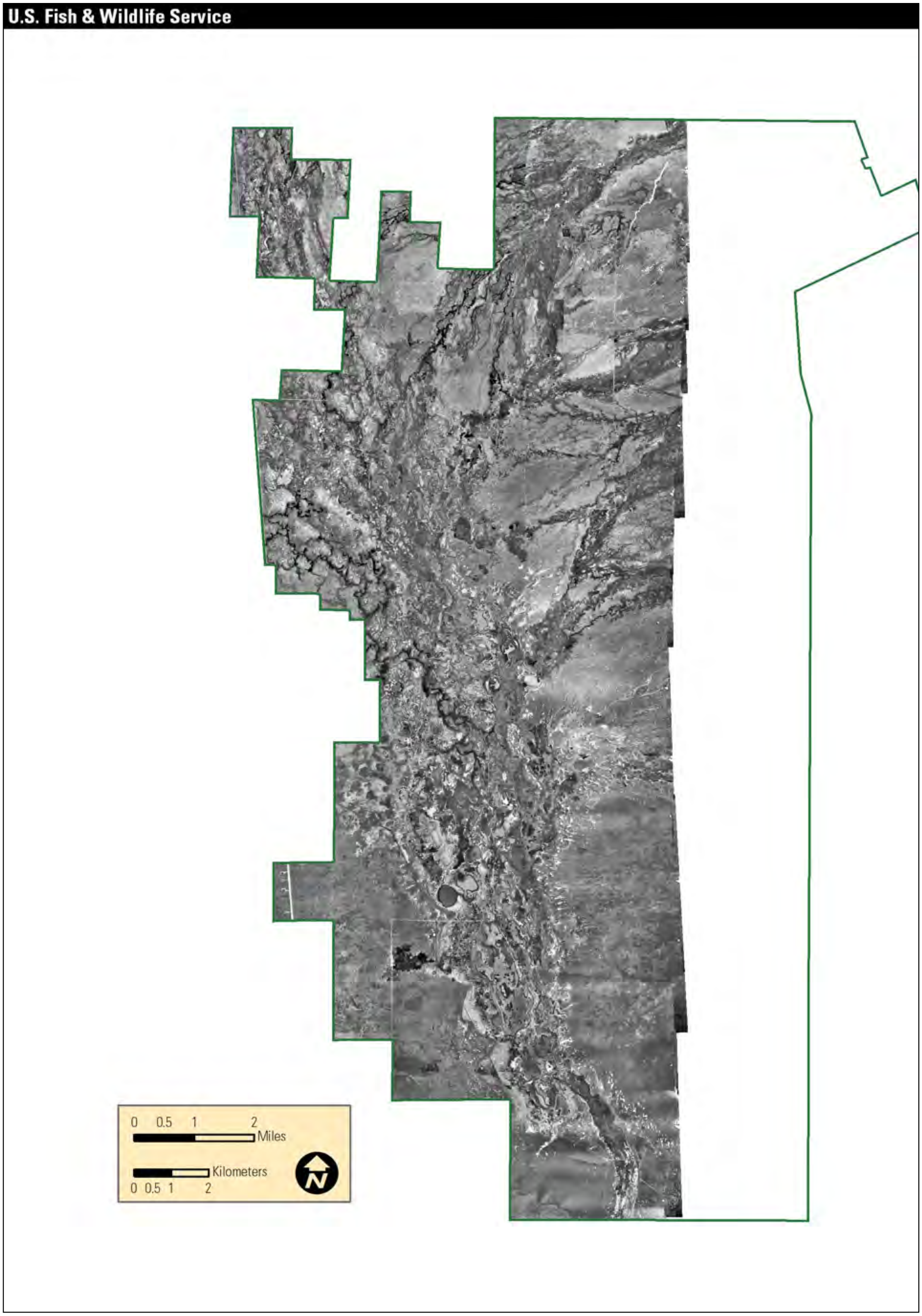

Figure 12. Aerial photograph of Baca National Wildlife Refuge, Colorado, in 1941.

On April 8, 2003, the Service acquired the first unit of the refuge when the 3,315-acre White Ranch property was transferred from the BOR to the Service (68FR11579), thus officially establishing the refuge. BOR purchased the White Ranch as part of a mitigation settlement for wetland losses resulting from the construction and operation of the Closed Basin Project, a division of the San Luis Valley Project (FWS 2005). In August 2005, Public Land Order 7641 transferred administrative jurisdiction of about 1,179 acres, including the surface and mineral estate and 3,991 acres of reserved Federal mineral estate, from BLM to the Service as part of Baca Refuge (70FR46536). Currently the Service has acquired about 85,941 acres. Of this, 28,558 acres are reserved from the public domain, 3,302 acres were acquired from another agency, and 54,081 acres were purchased by the Service (FWS 2013a) (figure 9). The largest remaining inholding within the authorized boundary is owned by The Nature Conservancy (TNC).

In 2009, Section 6 of the Great Sand Dunes National Park and Preserve Act was amended to explain the purpose and provide for the administration of Baca National Wildlife Refuge (Public Law 111-8; Omnibus Appropriations Act, March 11, 2009). The purpose of the Baca National Wildlife Refuge is to "restore, enhance, and maintain wetland, upland, riparian, and other habitats for native wildlife, plant, and fish species in the San Luis Valley." In administering the Baca National Wildlife Refuge, the Secretary shall, to the maximum extent practicable, "(A) emphasize migratory bird conservation; (B) take into consideration the role of the Refuge in broader landscape conservation efforts; and (C) '[subject to any agreement in existence as of the date of enactment of this paragraph, and to the extent consistent with the purposes of the refuge], use decreed water rights on the refuge in approximately the same manner that the water rights have been used historically.'"

In October of 2009, an interagency land exchange between the State of Colorado and the United States was approved which included lands owned by BLM, NPS, and the Service. Under this agreement, nearly 30,911 acres were added to Baca Refuge, about 25,765 acres of State land were added to the Great Sand Dunes National Park and Preserve, about 379 acres of State land were added to the BLM, and about 20,870 acres of BLM land were added to the State Land Board (DOI, BLM, and Colorado State Board of Land Commissioners 2009).

In 2013, we approved an interim elk management plan (FWS 2013e) for management of elk on the refuge complex until the CCP and EIS and required hunt management plans can be finalized.

Sangre de Cristo Conservation Area

The Sangre de Cristo Conservation Area was approved on September 15, 2012, as the 558th unit of the Refuge System. It will conserve a network of vital wildlife habitat on up to 250,000 acres of the Sangre de Cristo Mountains within Costilla and Alamosa counties through voluntary conservation easements. The acquisitions will focus on the protection of sagebrush habitat as well as in riparian corridors and associated uplands (FWS 2012b). On September 14, 2012, this new unit was established through an initial donation of 76,700 acres of land (77 FR 67830). Currently, over 167,200 acres have been protected through easements in the conservation area (FWS 2013a). Although it is part of the refuge complex, the

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Black-necked stilts skim the playa wetlands. A key purpose of all the refuges in the San Luis Valley is the protection of migratory birds.

A wetland area on Alamosa National Wildlife Refuge. The refuge was established in 1962.

actions described in this CCP and EIS do not apply to the Sangre de Cristo Conservation Area.

2.2 Special Values

Early in the planning process, the planning team and the public identified many outstanding qualities and values of the refuge complex. Refuge qualities are the characteristics and features of the refuge that make it special, valuable for wildlife and people, and worthy of national wildlife refuge status. These qualities can range from unique biological values to something simple like a quiet place to see a variety of birds and enjoy nature. The following summarizes the many qualities that make the refuge complex unique and valued:

- The refuge complex has large expanses of wet meadows and riparian areas that provide habitat for multiple life cycle needs for a high diversity of wildlife and plant species. Alamosa Refuge has large areas of protected wetlands along the Rio Grande corridor.

- The refuge complex provides habitat for many bird species including greater sandhill cranes, waterfowl, shorebirds, raptors, and passerines such as the endangered southwestern willow flycatcher. The entire Rocky Mountain population of greater sandhill cranes passes through the San Luis Valley during spring and fall migration. The refuge complex supports rare fish as well as many mammals, including mule deer, elk, coyote, porcupines, and Gunnison's prairie dogs.

- The refuge complex provides a variety of wetland habitats important for nesting and migration habitat for a diversity of waterbirds including ducks, white-faced ibis, American bitterns, and black-crowned night-herons. There is a high diversity of waterfowl and, locally, the refuges provide important nesting habitat. Wetlands on the refuges provide large areas of habitat for birds in the flyway. Historically, the area has had the capability to support a high density of nesting waterfowl species.

- Baca Refuge includes one of only two aboriginal Rio Grande sucker populations in Colorado.

- The refuge complex has about 1,300 vascular plant species, which makes the refuges some of the most diverse habitats in the West. The slender spiderflower is found on all three refuges.

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A cottonwood-willow riparian area along the Rio Grande in late fall. Ongoing drought and diversions along the river have affected the health of the river's riparian areas.

- The playa wetlands and sand sheets on the Baca Refuge are unique and important habitats. The area includes one of largest continuous sand sheet communities in the world.

- The headwaters of the Rio Grande begin just upstream of the San Luis Valley in the San Juan Mountains above Creede, Colorado. Historically, despite the desert environment, there has been an abundance of surface water in the valley due to mountain snowmelt.

- The San Luis Valley contains a unique confined aquifer system with artesian flows. There is also an unconfined aquifer. This is unusual, as these two types of aquifers are not often seen in proximity to one another. The refuges have surface and ground water rights with varying degrees of seniority and that are primarily designated for irrigation. Monte Vista Refuge has adjudicated water rights specifically for wildlife, which allows more flexibility than water designated exclusively for irrigation. Alamosa Refuge contains the last diversion on the Rio Grande in Colorado.

- There are 12,000 years of history and prehistory. This is a stunning period of time that is well documented. It is unusual to have this combination of abundance, quality, and continuous record of human history. The San Luis Valley has many important cultural resource sites, including the "Cattle Guard site" representing Paleoindian artifacts and the "Spanish Trail" site. There are over 2,000 known sites, which are probably a small fraction of what is really out there. The town of San Luis is the oldest incorporated town in the State.

- Nonprofits such as TNC broke ground for the Service to continue with preservation work and for the community to look at land conservation in a different way. Today, many nonprofit organizations exist in the valley.

- We have good relationships and partnerships with other agencies in addition to many opportunities to work with private partners for restoration actions.

- The Baca Refuge adjoins the Great Sand Dunes National Park and Preserve.
- The Monte Vista Crane Festival has become a significant tourist attraction in the valley and has become one of the largest wildlife viewing festivals in the State.
- There are beautiful landscape views as open lands provide tranquil reconnection to nature. There is not a lot of light pollution or noise pollution in the area, and the starry night sky and natural quiet, particularly around Baca Refuge and the adjacent Great Sand Dunes National Park and Preserve, are highly valued by local residents.
- The refuge complex's Friends group is a strong advocate for the refuge complex. Although the refuges are close to many communities and schools, many residents are not familiar with the refuges or the Refuge System. There is a huge opportunity to engage children and adults alike in discovering the wild places in their backyard.
- The area provides high-quality recreation opportunities. It has the best early season waterfowl hunting in the State. There is a potential for high-quality elk hunting.
- Although this is a sparsely populated valley, it is within a few hours of many urban areas. Monte Vista and Alamosa Refuges have auto tour routes and trails for birding and watching wildlife as well as offering high-quality hunting opportunities. There are many new opportunities for improved wildlife-dependent recreation, including opening Baca Refuge for public use.
- The Baca Refuge abuts lands owned by other conservation entities including NPS, TNC, CPW, and the Colorado State Land Board. Together these lands comprise a large and diverse assemblage of protected habitat.
- The refuge complex is part of a unique area with a variety of protected environments and large contiguous tracts of land managed by multiple agencies that work well together and a scientific community with high interest in the unique habitats.

2.3 Vision Statement

We developed a vision for the refuge complex at the beginning of the planning process. The vision describes the focus of refuge complex management and portrays a picture of the refuge complex in 15 years.

The San Luis Valley National Wildlife Refuge Complex, set in a high expansive desert valley, is cradled between the snow-capped peaks of the San Juan and Sangre de Cristo Ranges. Mountain snowmelt feeds the Rio Grande, numerous streams, and a dynamic ground water system creating a diverse mix of playas, wet meadows, and willow and cottonwood riparian corridors that are in stark contrast with the surrounding arid landscape. As reflected by 12,000 years of human history in the valley, the refuge complex attracts many people. Visitors experience the ancient song of the sandhill crane, witness evening flights of thousands of waterfowl, and listen to bugling elk. Through ever changing conditions like climate change, the refuges support and foster a collaborative spirit between their neighbors and partners to conserve the valley's treasured resources.

2.4 Goals

We developed seven goals for the refuge complex based on the Improvement Act, the purposes of the refuges, and information gathered during planning. These goals focus work toward achieving the vision and purposes of the refuges and outline approaches for managing refuge resources.

Habitat and Wildlife Goal

Conserve, restore, and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.

Water Resources Goal

As climate patterns change, we will protect, acquire, and manage surface and ground water resources to maintain and support management objectives.

Visitor Services Goal

Provide safe, accessible, and quality wildlife-dependent recreation and perform outreach to visitors and local communities to nurture an appreciation and understanding of the unique natural and cultural resources of the refuge complex and the San Luis Valley.

Partnerships and Refuge Complex Operations Goal

Secure and effectively use funding, staffing, and partnerships for the benefit of all resources in support of the refuge complex purposes and the mission of the Refuge System.

Actively pursue and continue to foster partnerships with other agencies, organizations, the water community and private landowners to conserve, manage, and provide for the long-term sustainability of working landscapes within the San Luis Valley ecosystem.

Cultural Resources Goal

Protect significant cultural resources within the San Luis Valley National Wildlife Refuge Complex.

Research, Science, and Wilderness Review Goal

Use sound science, applied research, monitoring, and evaluation to advance the understanding of natural resource functions, changing climate conditions, and wilderness values in the management of the habitats within the San Luis Valley ecosystem.

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The Baca ranch headquarters is part of an eligible historical district on the Baca Refuge.

Chapter 3—Alternatives


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Greater sandhill cranes and other waterfowl forage on a cold spring morning at Monte Vista Refuge. Many birds begin migrating north in late February

This chapter describes the proposed management alternatives for Monte Vista, Alamosa, and Baca Refuges. Alternatives are different approaches to management that are designed to achieve the purposes of each refuge, promote the vision and goals of each refuge, and further the mission of the Refuge System. We have formulated four alternatives, including the no-action alternative, to address significant issues that have been identified by the Service, cooperating agencies, interested groups, tribal governments, and the public during the public scoping period and throughout the development of the draft plan. Chapter 1 contains a discussion of the issues addressed in this CCP and EIS.

3.1 Criteria for Alternatives Development

Following the initial scoping process during the spring of 2011, we held meetings and workshops with the cooperating agencies and the public and identified a range of preliminary alternatives. Some ideas were eventually dropped, and those are discussed in section 3.10. We selected the following four alternatives for detailed discussion and analysis in the EIS:

- Alternative A—No-action Alternative
- Alternative B—Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Draft Proposed Action)
- Alternative C—Habitat Restoration and Ecological Processes
- Alternative D—Maximize Public Use Opportunities

These alternatives examine different ways of restoring and permanently protecting fish, wildlife, plants, habitats, and other resources and for providing opportunities for the public to engage in compatible, wildlife-dependent recreation. Each alternative incorporates specific actions that are intended to achieve the goals described in chapter 2. The no-action alternative would continue the current refuge management strategies and may not meet every aspect of every goal. The no-action alternative provides a basis for comparison with action alternatives B, C, and D. The action alternatives may vary with regards to how well they meet each of the goals. This is discussed further in chapter 5, section 5.12.

3.2 Elements Common to All Alternatives

Regardless of the alternative selected, the Service will comply with all applicable laws, regulations, and policies for management activities that could affect refuge resources such as soil, water, air, threatened and endangered species, and archaeological and historical sites. A list of key legislation and policies that we adhere to is found in appendix A. All the alternatives would adhere to the following guidelines:

- Significant cultural resources will be identified and protected. Individual projects may require consultation with the Colorado State Historic Preservation Office, tribal historic preservation offices, and other interested parties.

- Access to private inholdings and facilities involving BOR's Closed Basin Project will continue.

- Grazing, haying, and water lease fees will continue to be collected in accordance with Region 6 policies.

- Collaboration with our partner agencies or organizations will continue for established agreements, including the BOR Project Authorization Act of 1972, the Fish and Wildlife Reclamation Project Authorization of 1972, and the Fish and Wildlife Report for the Closed Basin Division, San Luis Valley Project, Colorado, 1982. Cooperation and collaboration with Federal, State, tribal, and local governments; nongovernmental organizations; and adjacent private landowners will continue. Section 3.11 describes existing and potential partnerships.

- All prescribed fire activities will be carried out under an approved and current fire management plan that conforms with DOI and FWS policies.

- Control of invasive weeds and integrated pest management will continue, using a variety of tools such as grazing and biological, chemical, and mechanical controls. We will continue to work in partnership with others to reduce weed infestations.

- By law and policy, we will continue to abide by all State water regulations regarding the use of surface and ground water. It is important to note that the ability to use all water sources on these national wildlife refuges is the result of the adjudication process of the Colorado Water Court. The resulting court decrees often define when, where, and for what beneficial use water can be diverted, used, and consumed. All changes in water use described in this plan must either be within the limits described in the existing decree for the specific water source or result from a successful application to and approval by the State Engineer and/or the court.

- We will continue to acquire land within the authorized boundary areas of the refuge complex. These lands will be purchased from willing sellers as money becomes available.

- We will continue to manage game in accordance with Service policy. All hunters will be required to possess valid State-issued hunting licenses and Federal and State stamps for waterfowl hunting (as applicable) and must have these with them while hunting. Hunting will be allowed only in designated hunting areas as posted and shown on the maps. Hunters will be required to park in designated parking areas and must abide by all other refuge-specific regulations. Bird collection for falconry will not be allowed.

- All Service polices regarding rules and regulations for oil, gas, and mineral extraction on refuge lands will be adhered to. Many of the minerals underlying the Baca Refuge are privately owned (not owned by the United States). Access to these minerals by the private owner is regulated by Federal and State law which, in part, requires the U.S. Fish and Wildlife Service, as owner of the surface estate, to place reasonable restrictions on the mineral owner's access so as to reduce disturbance to the surface estate.

3.3 Structure of Alternative Descriptions

Since each alternative is designed to address the goals described in chapter 2, the alternatives are organized by the following goal headings:

- Habitat and Wildlife Resources
- Water Resources
- Visitor Services
- Cultural Resources
- Partnerships and Refuge Complex Operations
- Research, Science, and Wilderness Review

3.4 Alternative A (No Action)

Under the no-action alternative, we would make few changes in how we manage the various habitats and wildlife populations throughout the refuge complex. We would continue to manage habitats on the Monte Vista and Alamosa Refuges through the manipulation of water as described in the 2003 CCP (FWS 2003). Water management on the Baca Refuge would continue under the guidance found in the conceptual management plan for Baca Refuge. All the refuges would adhere to new State regulations regarding water use. There would be few added public uses outside of those that already occur on the Monte Vista and Alamosa Refuges (figure 13 and figure 14). Baca Refuge would remain closed to public use except for potential access to a refuge office or contact station (figure 15). We would keep our existing partnerships in and around the refuge complex.

Habitat and Wildlife Resources

On all three refuges, we would continue to manage wetland areas, especially wet meadows, to provide for a variety of waterbirds. Riparian and upland habitats would be managed for migratory birds. We would continue to produce small grains at current levels on the Monte Vista Refuge (up to 270 acres) to provide food for spring-migrating sandhill cranes.

There would be few changes made in managing big game populations. Elk numbers would continue to fluctuate from 1,000 to 4,000 individuals, with most of the population on the Baca Refuge. Population distribution and control would be limited to nonlethal dispersal, agency culling, and public dispersal hunts (also called distribution hunts) on the former State lands of Baca Refuge. Details of these proposals are now available as part of an interim elk management plan (FWS 2013e).

We would continue to protect populations of and manage habitats for threatened and endangered species as well as for species of concern. These species include southwestern willow flycatcher, Rio Grande sucker, Rio Grande chub, and northern leopard frog.

We would phase out the existing arrangement with TNC for season-long bison use on those parts of the Medano Ranch that are within the Baca Refuge boundary, and we would not use bison as a management tool in the future.

We would continue to use prescriptive livestock grazing, haying, and cooperative farming as management tools for maintaining habitats within the refuge complex. We would continue to control invasive and noxious weeds. Similarly, we would continue to follow fire funding guidelines in the prioritization of fuels treatments and use of fuels funding. We would pursue alternative funding sources for prescribed fire implementation.

Water Resources

We would maintain our ability to use our water rights within the refuge complex. The use of ground water would continue, except as modified by changing State rules, regulations, and policies. All the refuges within the refuge complex will continue to use and augment water supplies in accordance with State law.

Visitor Services

Compatible, wildlife-dependent public uses, including waterfowl and small game hunting, would continue to be allowed on the Monte Vista and Alamosa Refuges, but we would not seek to establish elk hunting on any of the refuges other than the authorized distribution hunts on the Baca Refuge (FWS 2013e) (figures 13,14, and 15).

The auto tour routes on the Alamosa and Monte Vista Refuges, along with the existing nature and walking trails, would continue to provide some wildlife observation, interpretation, and photographic opportunities. We would open the visitor center on the Alamosa Refuge on a part-time basis as volunteer resources allow. Our primary environmental education events such as the Monte Vista Crane Festival, the Kids Crane Festival in the fall, the Kid's Fishing Day, and other activities would continue.

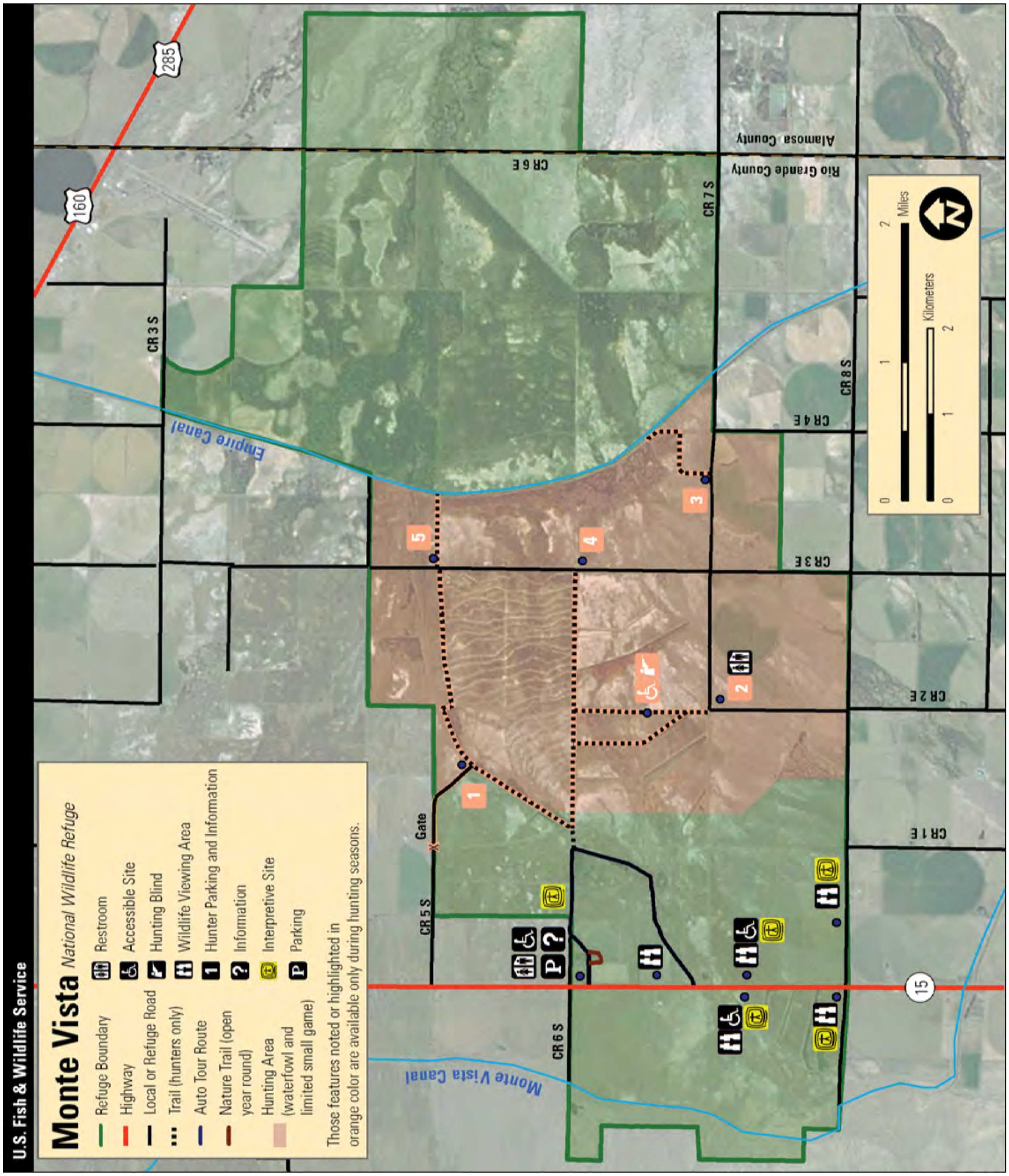

Figure 13. Map of alternative A for Monte Vista National Wildlife Refuge, Colorado.

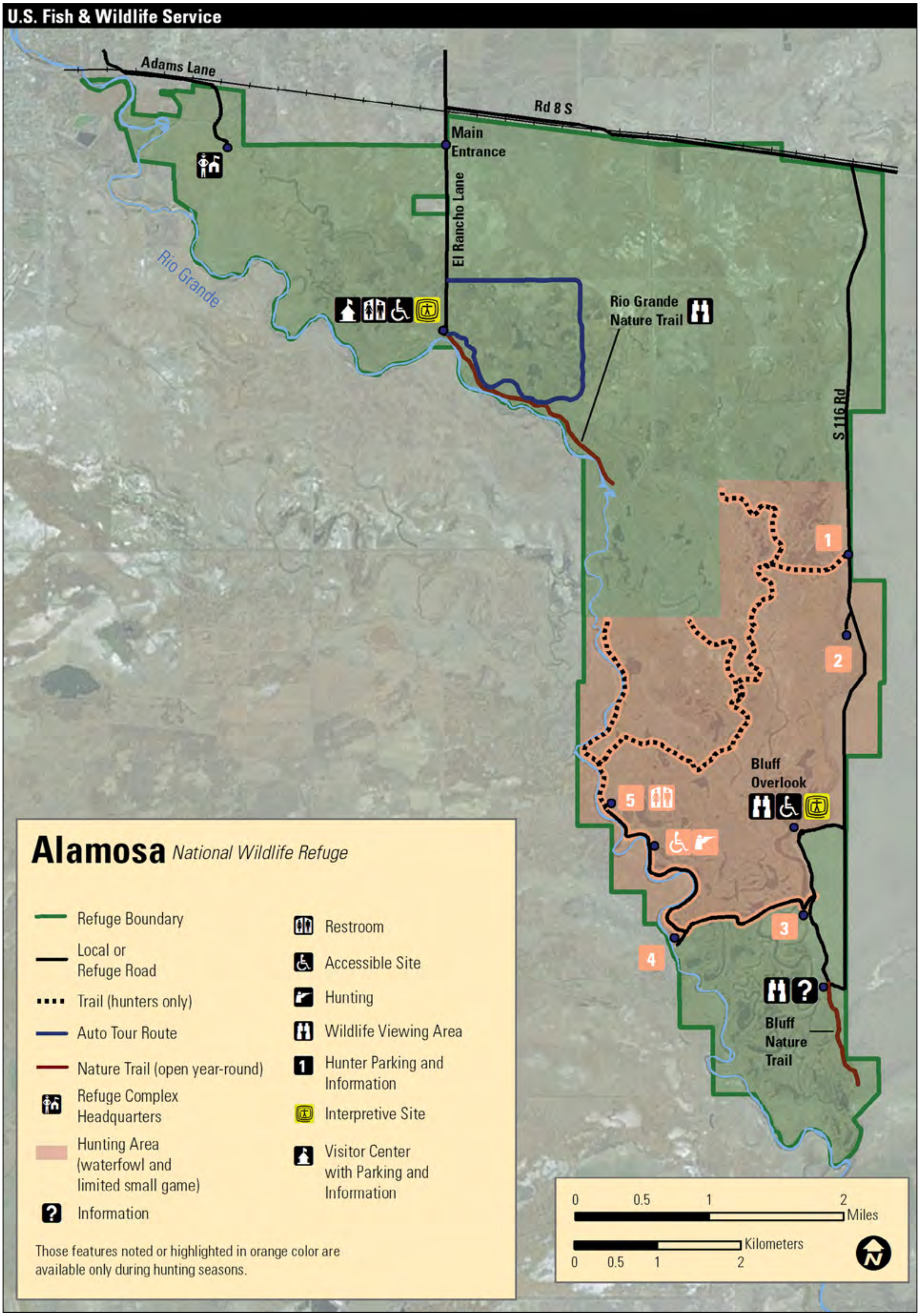

Figure 14. Map of alternative A for Alamosa National Wildlife Refuge, Colorado.

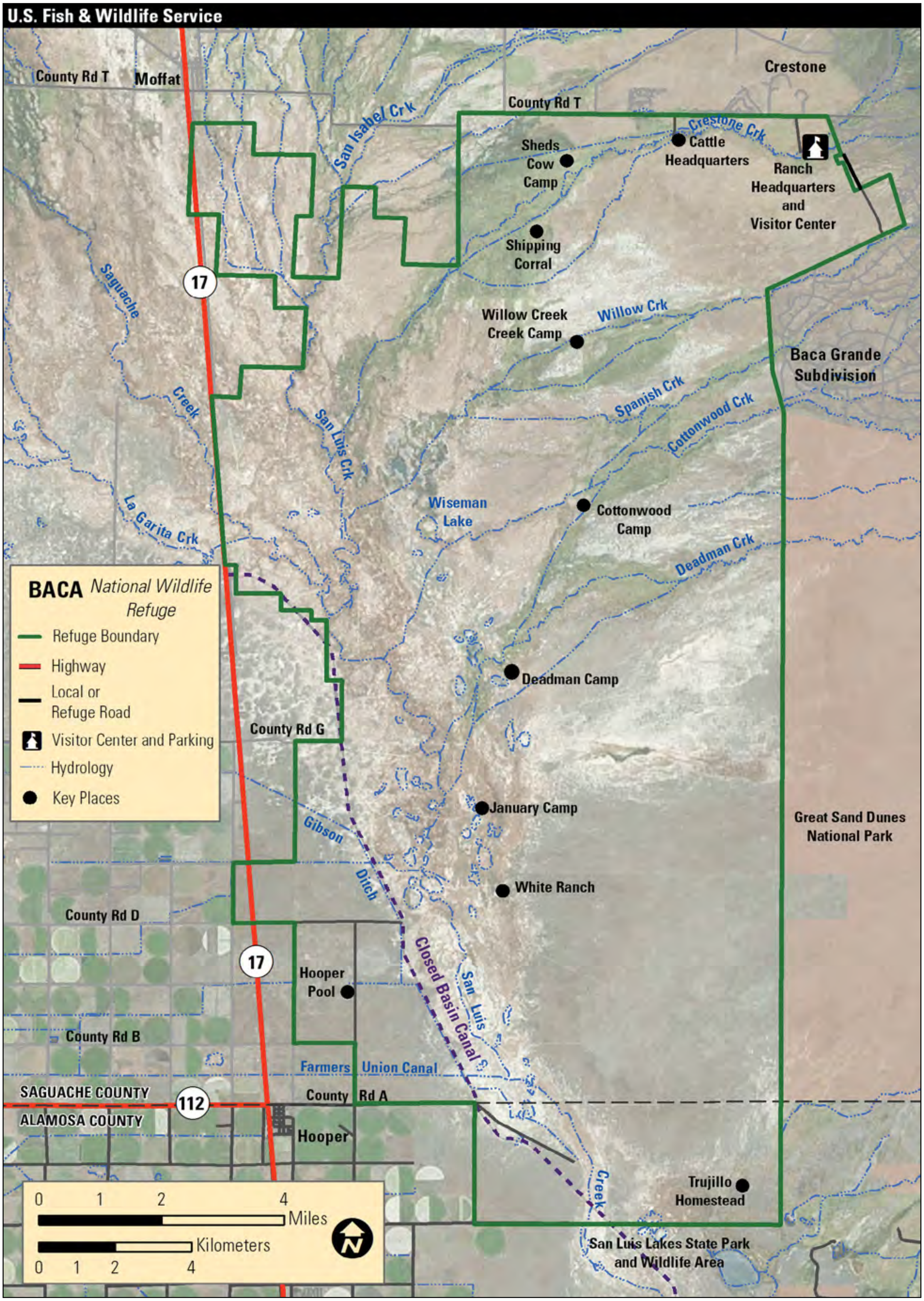

Figure 15. Map of alternative A for Baca National Wildlife Refuge, Colorado.

Public access via trails or a tour route would not be established on the Baca Refuge, and the refuge would remain closed to the public except for occasional staff-led tours and access to an office or visitor contact station. A refuge office with a visitor contact station was recently approved for construction at the Baca Refuge, and a few interpretive kiosks or other facilities would be installed.

Cultural Resources and Tribal Coordination

Under Section 106 of the National Historic Preservation Act, we would continue to conduct cultural resource reviews for projects that disturb the ground or that could affect buildings or structures over 50 years of age. We would avoid disturbing significant cultural resources unless such disturbance is required by unusual circumstances. In addition, we would continue to conduct law enforcement patrols and monitor sensitive sites. As required, we would consult with the Colorado State Historic Preservation Office and Native American tribes and we would adhere to other cultural resource laws.

Partnerships and Refuge Complex Operations

We would continue to work with a variety of other agencies and non-profit organizations including our Friends group (refer to 3.17 for a list of the many partnership organizations we work with in the San Luis Valley) to achieve our goals for habitat and wildlife management. Refuge complex operations would continue within existing funding levels. As such, there would be few new financial resources available to increase programs or services.

We would continue to coordinate and work with adjacent landowners to reduce potential conflicts.

In accordance with the provisions of the interim elk management plan (FWS 2013e), we would work with CPW to coordinate dispersal hunts, hazing, and lethal removal of elk by agency staff to reduce damage to neighboring lands as well as riparian habitats on the refuges.

The use of haying, livestock grazing, and other habitat management tools with an economic benefit would be managed through special use permits and would conform to all Service policies. We would work with owners of separated mineral rights to limit potential effects on the surface estate and other associated resources. We would continue to be active and contributing partners in the San Luis Valley Interagency Fire Management Unit. This partnership includes the USFS, NPS, BLM, the State of Colorado, and the Service.

On all three refuges, we would continue to inventory, maintain, rehabilitate, and replace structures, including those with historic significance. When practical, unneeded structures that are not historically significant would be removed and not replaced. We would continue to maintain our fencing, including constructing new fences, removing unnecessary fences, and retrofitting fences for compatibility with wildlife.

Research, Science, and Wilderness Review

Within existing funding levels, we would continue to inventory and monitor habitat and wildlife resources with existing refuge staff as well as by working with the USGS and other agencies and organizations.

No lands within the refuge complex would be recommended for wilderness protection.

3.5 Alternative B—Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Draft Proposed Action)

Under this alternative, we would approach management with an emphasis on maintaining or restoring the composition, structure, and function of the natural and modified habitats within the refuge complex. We would consider the ecological site characteristics and wildlife species needs on our refuge lands by developing sound and sustainable management strategies that preserve and restore ecological (biological) integrity, productivity, and biological diversity. We would apply strategic habitat conservation principles (a structured, science-driven, and adaptive approach; see chapter 1, section 1.3) in determining how to best manage our lands for native fish, wildlife, and plant species, with a particular emphasis on migratory birds, waterfowl, and declining or listed species. Compatible wildlife-dependent public uses would be enhanced and expanded to include all three refuges (figures 16, 17, and 18). Figures 25, 26, and 27 below show the potential future habitat conditions for the three refuges under alternative B. Refer to chapter 4, section 4.3 for maps of the current vegetation conditions for the three refuges. We would facilitate the protection, restoration, and conservation of important water resources through partnerships, public education, and stewardship.

Habitat and Wildlife Resources

We would manage our natural and constructed wetland areas within the refuge complex to achieve a variety of wetland types and conditions. These wetlands would be managed to support a diversity of migratory birds and other wildlife, with a specific focus on surrogate and focal species that represent the Service's and other partners' larger conservation goals. (Refer to chapter 1, section 1.3). We would work to restore historical flow patterns through more effective water management practices and the continued use of prescriptive grazing, haying, and fire. We would prioritize the restoration of our riparian areas to improve habitat conditions for many species. We would place our highest priority on restoring riparian habitat along streams in the Baca Refuge as well as on off-channel sites along the Rio Grande on the Alamosa Refuge where soil and available water are conducive to restoring willow and cottonwood habitat. We would manage upland habitats to create a variety of seral stage conditions that provide habitat for a diverse array of wildlife species, particularly nesting and migrating focal birds.

We would use public hunting to complement the State's management, working together to keep elk populations at levels that would allow us to sustain healthy plant communities both in the refuge complex and on neighboring lands. This would include opening portions of the Baca Refuge to public hunting and opening parts of the Alamosa and Monte Vista Refuges to a limited public dispersal hunt. We would work with our partners (CPW, NPS, BLM, USFS, and other conservation organizations) to manage elk populations.

We would work with other Federal and State agencies as well as other conservation partners to improve habitats for threatened and endangered species and other species of concern. Particular focus would be on riparian areas, which are habitat for southwestern willow flycatcher, and riverine systems, which are habitat for Rio Grande sucker and Rio Grande chub. In addition, habitats for other native species of concern such as Gunnison's prairie dog and northern leopard frog would be protected, restored, and enhanced where practical and necessary.

As with alternative A, the existing arrangement with TNC for bison management on former State lands within the Baca Refuge would be phased out. Since bison are important to other stakeholders and partners, we would research the feasibility, potential, and suitability of using semi-free-ranging bison year-round to effectively maintain and enhance certain refuge habitats.

We would also use traditional prescriptive livestock grazing and haying to manage habitats within the refuge complex. We would continue to grow limited amounts of small grain on the Monte Vista Refuge (about 190 acres) to provide necessary food for the Rocky Mountain population of greater sandhill cranes, as specified in the management plan for the Pacific and central flyways for the Rocky Mountain greater sandhill cranes. Constant and consistent evaluation and monitoring of habitats would occur to make sure that objectives were being met.

We would control and reduce the incidence of invasive weeds such as tall whitetop, Russian knapweed, Canada thistle, saltcedar, and reed canarygrass through more effective management and by using prescribed fire as well as chemical, mechanical, and biological control methods. We would make every effort to increase weed control in sensitive habitats or where there is a risk of weeds spreading to neighboring private land.

We would strengthen the fire program within the refuge complex by improving fire management planning and by increasing coordination with partners. Whenever possible, we would use prescribed fire to help achieve our habitat management objectives (refer to section 3.9), and we would conduct prescribed fires on a more consistent basis. We would pursue more funding to protect property and human safety under the wildland-urban interface guidelines, and, where possible, we would reduce the number of individual facilities that would require fire protection.

Water Resources

We would continue to work with other landowners and agencies throughout the watershed to keep flexibility as well as to protect and, if necessary, augment our water rights as State regulations evolve. Water quality standards would be established and studies would be initiated to help protect water rights; prioritize habitat management and planning; and develop concise water use reporting methods. Our ground water use would comply with new State

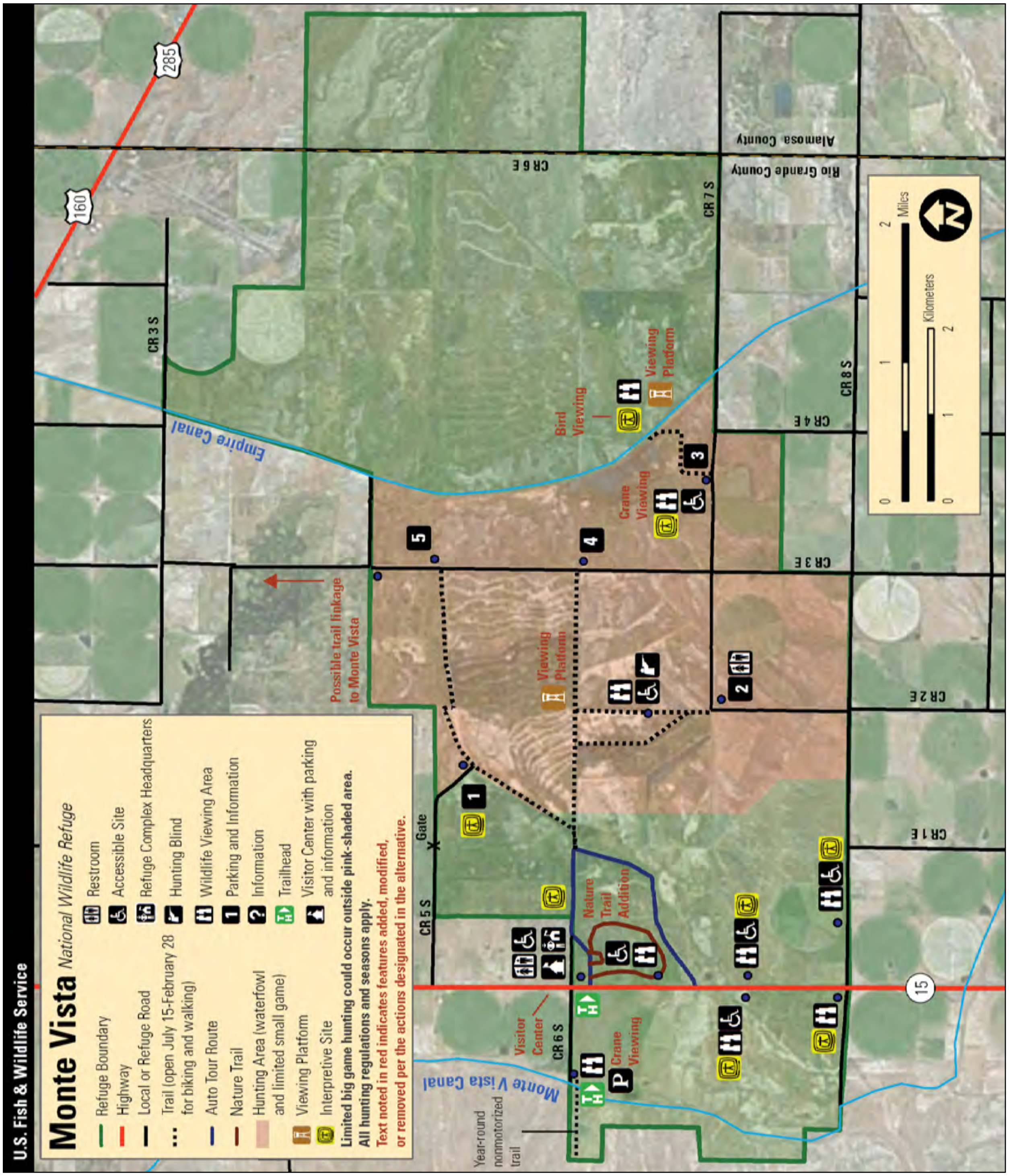

Figure 16. Map of alternative B for Monte Vista National Wildlife Refuge, Colorado.

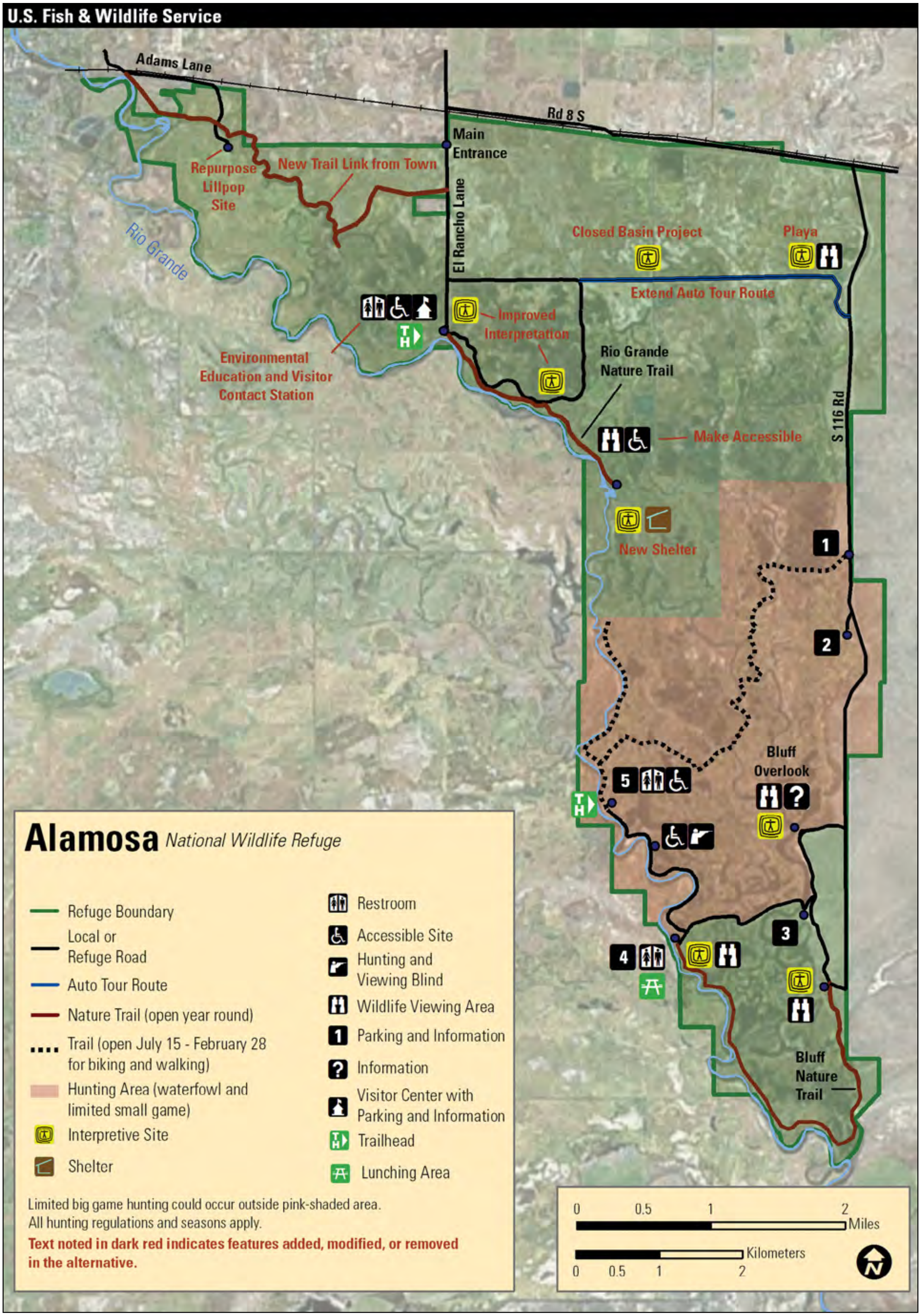

Figure 17. Map of alternative B for Alamosa National Wildlife Refuge, Colorado.

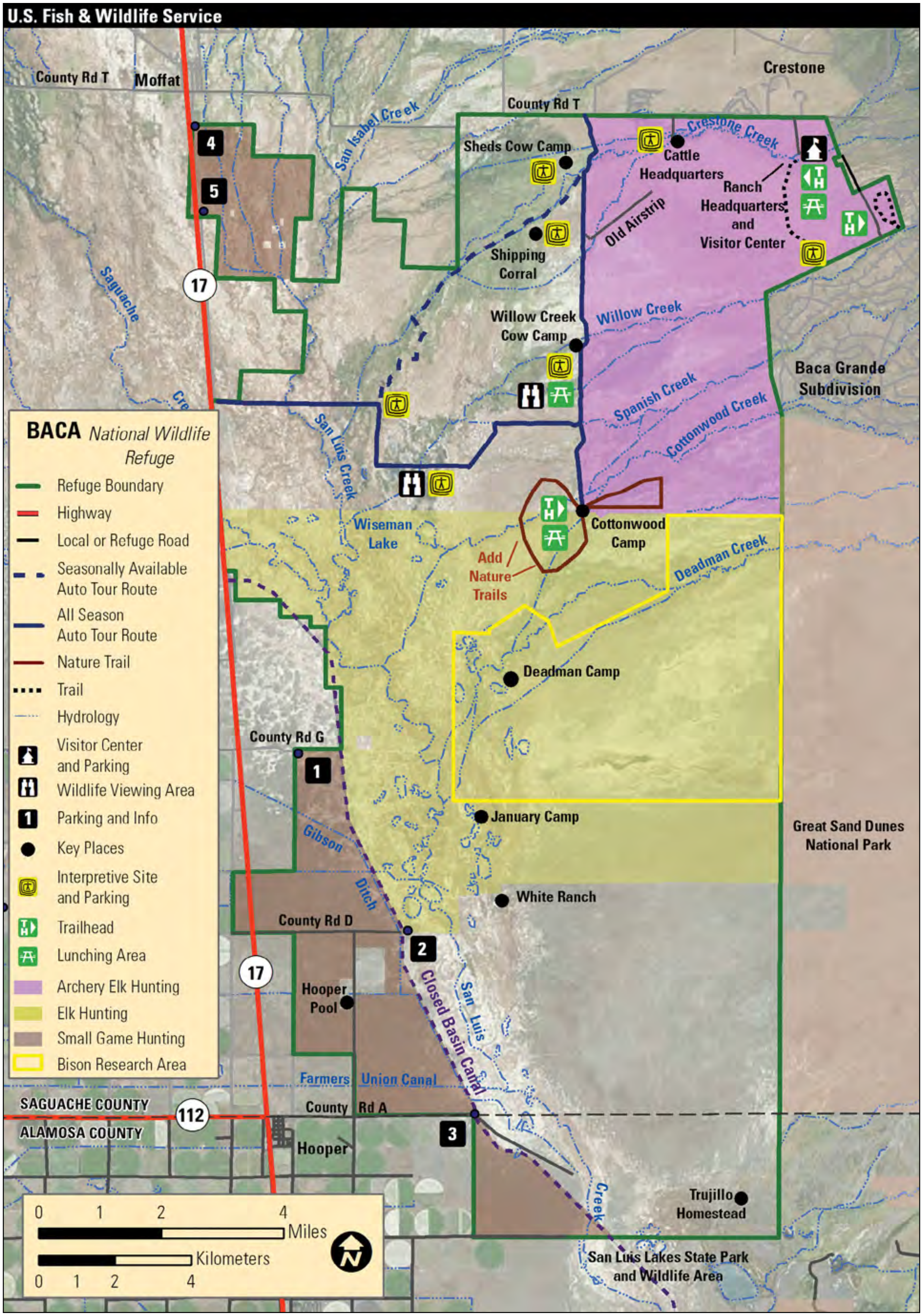

Figure 18. Map of alternative B for Baca National Wildlife Refuge, Colorado.

ground water rules and regulations through augmentation plans or by working with others and contracting with ground water management subdistricts.

We would achieve our habitat management objectives while providing for quality visitor experiences and we would improve our water infrastructure, delivery, and efficiency to make sure that habitat objectives are met.

Visitor Services

We would continue to offer hunting for waterfowl and small game on the Monte Vista and Alamosa Refuges. We would open the Baca Refuge for big and small game hunting, and we would offer public dispersal elk hunts and conduct agency dispersal hunting on the Monte Vista and Alamosa Refuges. This would provide recreational opportunities while enabling us to manage the numbers and distribution of elk. Access points and parking areas would be developed on the Baca Refuge (figures 16, 17, and 18).

General public access would be improved on the Monte Vista and Alamosa Refuges and established on the Baca Refuge. We would allow for more access for wildlife viewing and interpretation from about July 15 to February 28 on roads that are currently only open to hunters during hunting season. Modes of access such as cross-country skiing and bicycling that facilitate wildlife-dependent uses would be favored on all three refuges. Portions of the Baca Refuge would be opened for limited public use, and nonmotorized access, including walking, biking, and limited horseback riding, would be allowed. An auto tour route would be built on the Baca Refuge. The construction of more trails or viewing platforms on the Monte Vista and Alamosa Refuges would be considered. Limited commercial opportunities such as photography could be considered. We would seek funding to build a visitor center and refuge complex staff offices at the Monte Vista Refuge to better serve the public, provide for safer access to our offices, and provide a modern work environment for our employees. In coordination with our Friends group, we would continue to host the Kid's Fishing Day on the Monte Vista Refuge.

Cultural Resources and Tribal Coordination

Most of our actions would be similar to alternative A, plus we would increase our efforts toward identifying and protecting significant resources.

Partnerships and Refuge Complex Operations

When the Baca Refuge was established under the Great Sand Dunes National Park and Preserve Act of 2000, operations funding did not come with the added management responsibilities. In order to meet our management objectives, we would seek more funding for the refuge complex for habitat conservation, visitor services, and maintenance. Overall, refuge complex offices are inadequate and provide for little visitor contact. We would seek to increase our staff levels of both full-time and seasonal employees, as well as seek funding for safe access and accessible offices for our staff and visitors.

We would continue to collaborate with CPW and other agencies to effectively manage elk, which would hopefully result in an improved distribution across the local game management units (GMUs).

We would continue to work closely with the San Luis Valley Interagency Fire Unit to achieve habitat management objectives while minimizing risk to sensitive habitats and human structures. We would seek funding for a more dependable prescribed fire program. We would develop working relationships with neighboring landowners and others to address interface issues such as invasive species control, shared fence management, elk management, and other concerns.

As with alternative A, the use of haying, livestock grazing, and other habitat management tools with an economic benefit would be managed through special use permits and would conform to all Service policies.

On the Baca Refuge we would work extensively with owners and developers of third-party-owned mineral rights to find ways to reduce the effects of future exploration activities on visitors and wildlife and to locate exploration and production facilities away from visitors.

Research, Science, and Wilderness Review

We would increase monitoring efforts to gain a better understanding of the effects of management actions on habitat conditions, wildlife populations, and water resources. We would also research the effects of climate change. We would recommend that about 13,800 acres along the southeastern boundary of the Baca Refuge be managed as a wilderness study area and be considered for eventual wilderness designation (refer to figure E1 in appendix E).

3.6 Alternative C—Habitat Restoration and Ecological Processes

We would take all feasible actions to restore or mimic, where needed, the native vegetation community based on site characteristics, ecological processes, and other factors. We would continue to have compatible wildlife-dependent public uses, but they could be adapted in response to changes in area management (figures 19, 20, and 21). Our partnership efforts would be broadened and geared toward restoring native vegetation communities and mimicking natural hydrologic conditions. Figures 25, 26, and 27 identify potential habitat conditions for the three refuges under alternative C.

Habitat and Wildlife Resources

We would restore vegetative communities in the refuge complex to mimic ecological conditions that existed before Euro-American settlement of the area. For example, we would restore the function of the riparian areas and playas on the Baca Refuge. We would apply natural disturbance regimes such as prescribed grazing and fire in other habitats. Where practical, we would restore natural waterflow patterns. We would stop producing small grains for spring migrating sandhill cranes on the Monte Vista Refuge.

We would use hunting to manage the size or distribution of elk populations and improve the long-term health of riparian habitat. Similar to alternative B, our priority would be to improve habitat for all native species, but particularly threatened and endangered species and other species of concern. For example, we would protect or restore riparian areas for southwestern willow flycatcher along the Rio Grande on the Alamosa Refuge and reintroduce Rio Grande chub and Rio Grande sucker to the creeks on the Baca Refuge where they historically occurred.

As with alternative B, we would phase out the existing arrangement with TNC for bison on former State lands. Knowing that bison historically occurred at least to some extent in the San Luis Valley, we would attempt to periodically use bison on the Baca Refuge to mimic the ecological services they may have once provided.

Similar to alternative B, we would intensify our efforts to combat invasive plants. Steps would be taken to strengthen the fire program within the refuge complex and use prescribed fire to restore and maintain native plant communities.

Water Resources

We would manage water to restore the hydrologic conditions with less focus on habitat management for specific species or for providing wildlife viewing. We would evaluate the need to supplement existing water supplies while considering restoration of historic hydrology, especially on the Monte Vista and Alamosa Refuges. In some years, water might not be available to meet life cycle needs for some waterfowl species. Existing water infrastructure would be removed or modified as needed. Water quality monitoring would also be increased.

Visitor Services

We would continue to allow waterfowl and limited small game hunting on the Monte Vista and Alamosa Refuges. Similar to alternative B, we would open the Baca Refuge for big game and small game hunting. On the Monte Vista and Alamosa Refuges, we would rely on public hunting or agency dispersal methods for elk management (figures 19, 20, and 21).

There may be changes in public use, depending on the habitat management action. Some areas could be closed. Current public access would be evaluated on the Alamosa and Monte Vista Refuges. If existing roads or trails are not needed or if these facilities fragment habitat, they could be removed or altered. Viewing areas for sandhill cranes may be moved, depending on restoration efforts. Service participation in the Monte Vista Crane Festival could be adjusted, depending on changes in the location and concentration of sandhill cranes. We would provide on-site interpretation and environmental education programs on the Alamosa and Monte Vista Refuges as funding allows, and our key messages would relate to our restoration efforts.

Except for limited hunting access to achieve management objectives, there would be no facilities or programs on the Baca Refuge. For example, an auto tour route, nature trails, and restrooms would not be developed.

Cultural Resources and Tribal Coordination

Actions would be similar to those under alternative B.

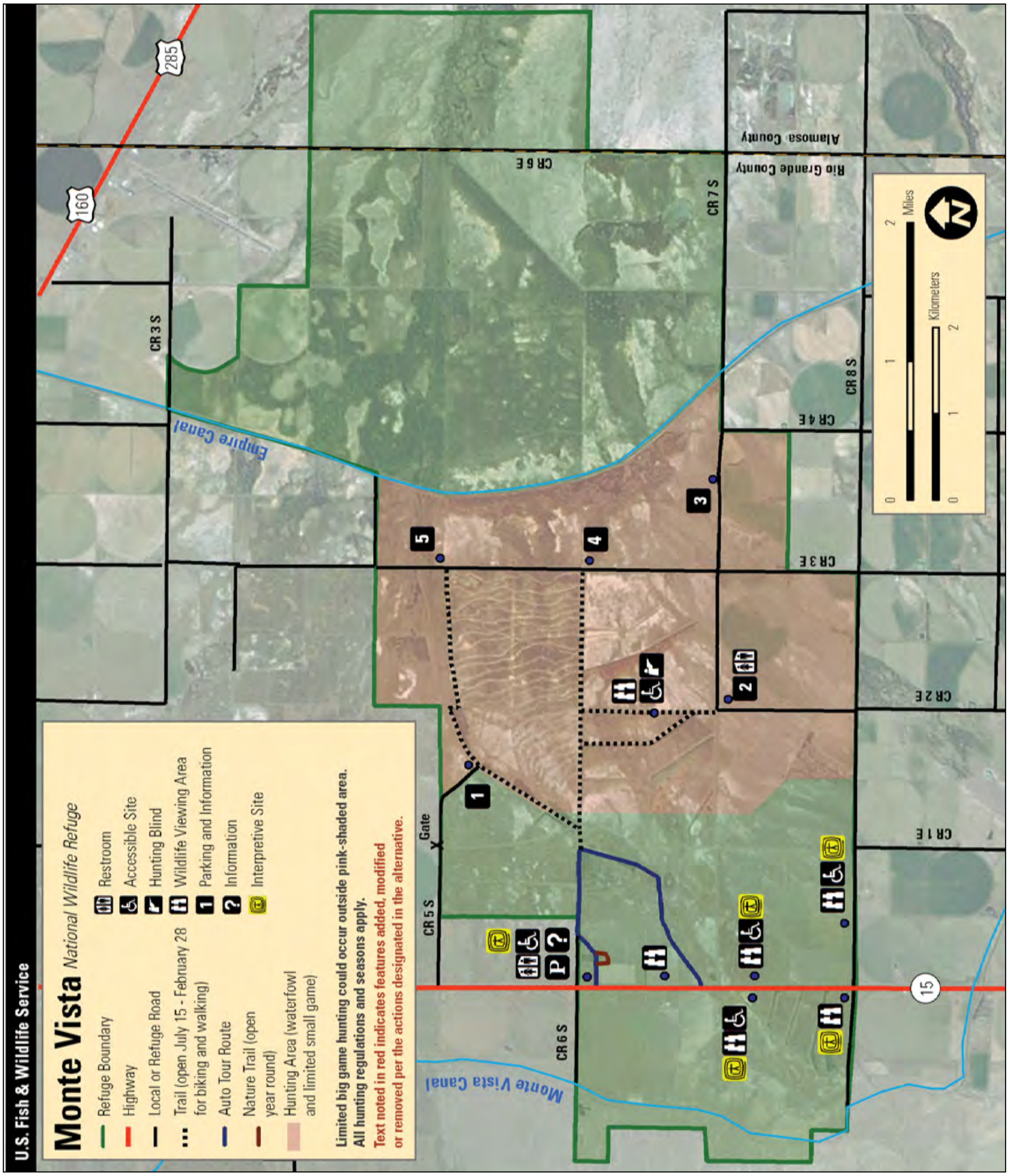

Figure 19. Map of alternative C for Monte Vista National Wildlife Refuge, Colorado.

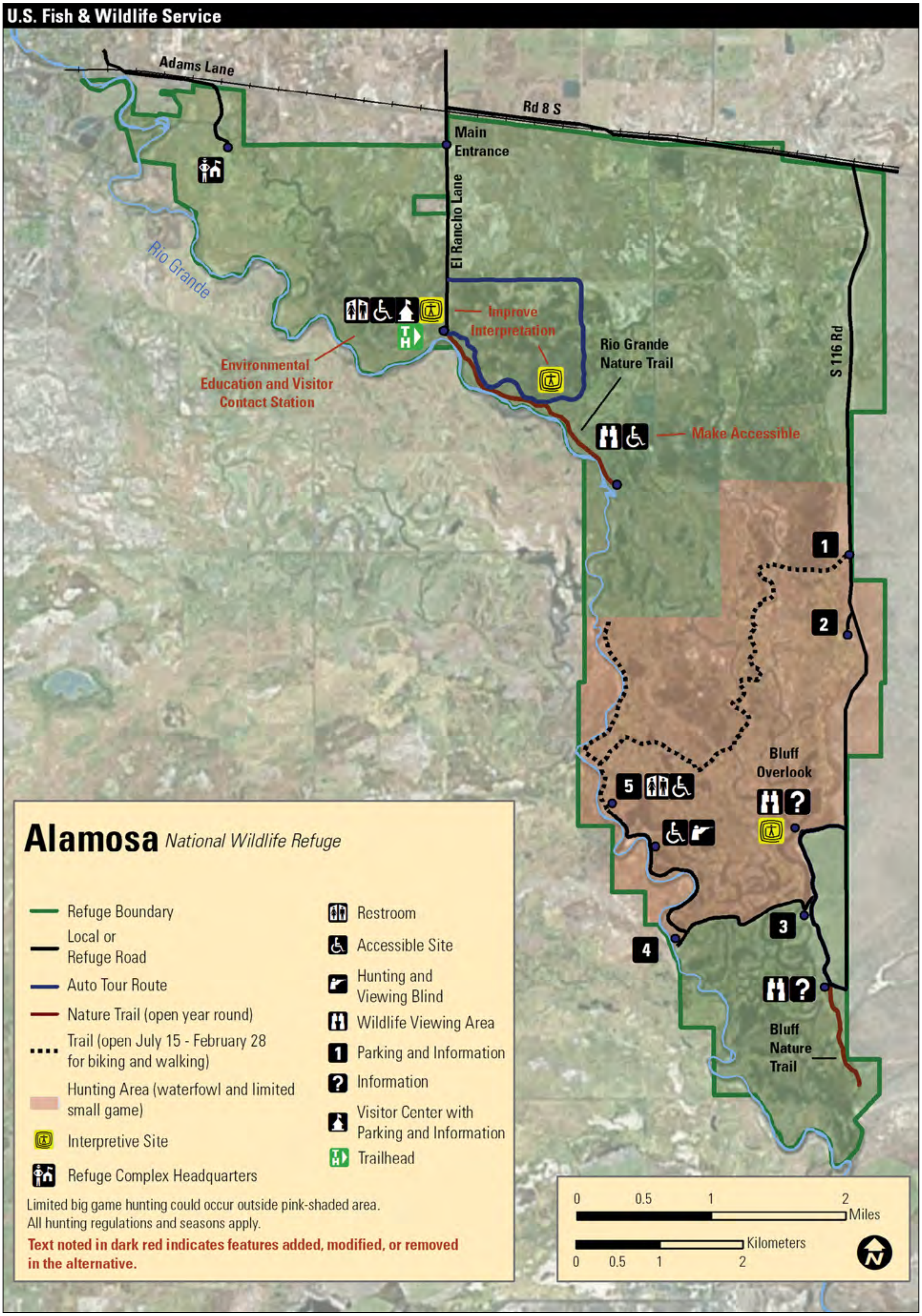

Figure 20. Map of alternative C for Alamosa National Wildlife Refuge, Colorado.

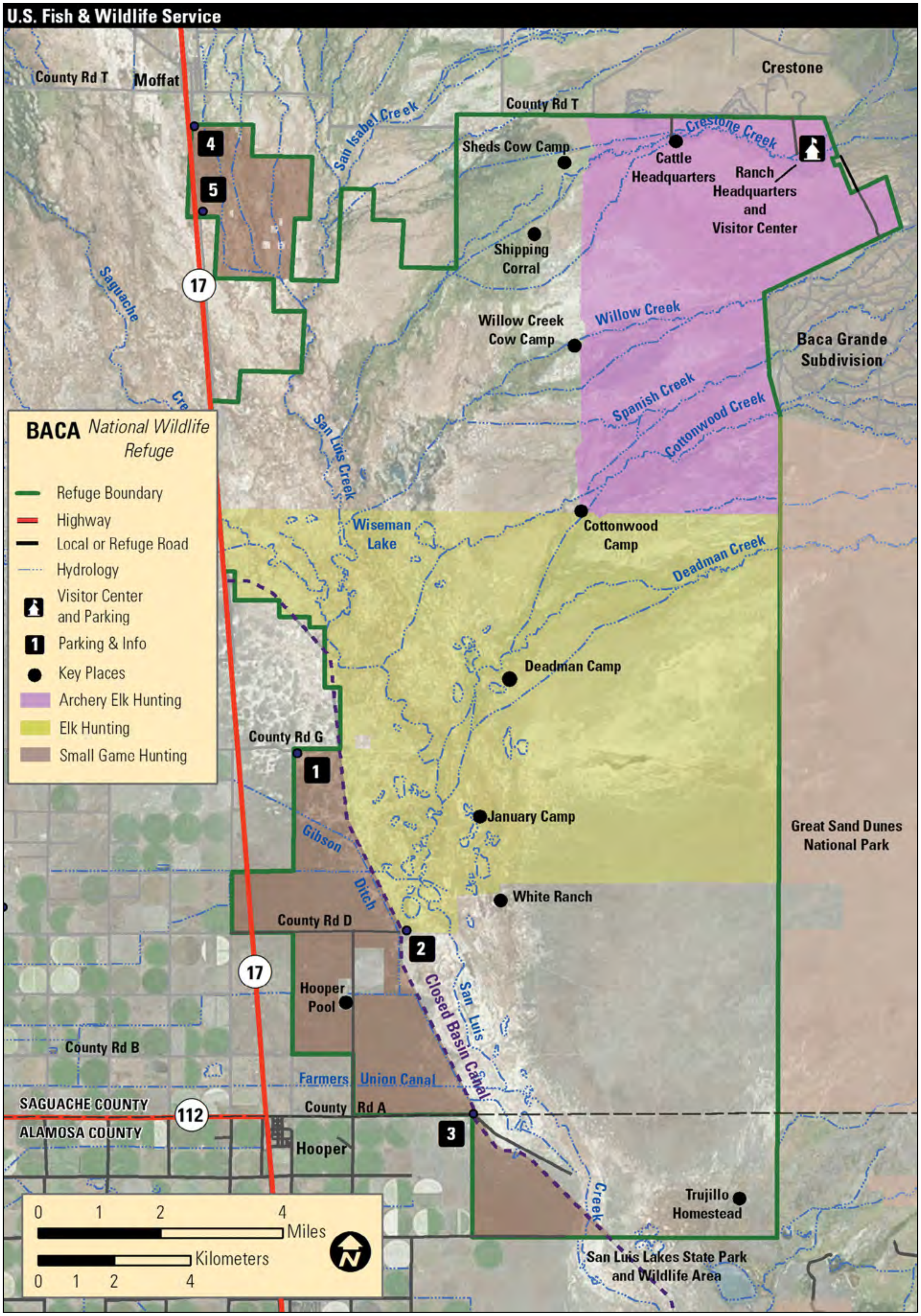

Figure 21. Map of alternative C for Baca National Wildlife Refuge, Colorado.

Partnerships and Refuge Complex Operations

We would seek to increase partnerships with a variety of agencies, organizations, and universities to achieve management objectives, restore ecological processes, and improve the efficiency of overall refuge management operations. On the Baca Refuge, current Lexam and gravel roads would be evaluated, and roads that are not needed or that are fragmenting habitat would be removed. As with alternative A, the use of haying, livestock grazing, and other habitat management tools with an economic benefit would be managed through special use permits and would conform to all Service policies.

Research, Science, and Wilderness Review

Similar to alternative B, we would increase efforts in studying habitats and wildlife, particularly with respect to climate change as well as to land and water protection.

Similar to alternative B, we would recommend that about 13,800 acres along the southeastern boundary of the Baca Refuge (refer to figure E1, appendix E) be managed as a wilderness study area.

3.7 Alternative D—Maximize Public Use Opportunities

We would manage wildlife and habitats consistent with our mission and purposes for the refuges while emphasizing quality visitor experiences and compatible wildlife-dependent public uses. Partnerships that complement our efforts to accommodate and provide for the priority public uses would be strengthened (figures 22, 23, and 24). Figures 25, 26, and 27 show the potential future habitat conditions for the refuges under alternative D.

Habitat and Wildlife Resources

Similar to alternative A, we would manage wetlands to maximize waterbird production at the Monte Vista and Alamosa Refuges. We would also irrigate areas that are closer to public access and viewing areas at the Baca Refuge to enhance wildlife viewing. Riparian and upland habitats would be conserved for migratory birds. We would continue the agricultural production of small grains for sandhill cranes on the Monte Vista Refuge (about 230 acres), except grain production could also be used in a specific place or time to enhance wildlife viewing. A key difference from alternatives A and C, but similar to alternative B, is that we would improve public education about, and interpretation of, the role that the refuge complex plays in the San Luis Valley and across the Refuge System.

We would offer opportunities for elk hunting and viewing. Elk numbers would be managed at levels that would restore and foster the long-term health of native plant communities.

We would collaborate with other agencies for public access, law enforcement, and elk management. Similar to alternative B, habitats for native species and threatened, endangered, and other species of concern would also be improved, but we would emphasize public education in our restoration efforts.

Similar to alternatives B and C, the existing arrangement with TNC for bison management on former State lands at the Baca Refuge would be phased out. We would introduce and manage a small bison herd on a confined area of the Baca Refuge. Wildlife viewing and interpretation opportunities would be emphasized and incorporated into this program.

Similar to all other alternatives, invasive and noxious weeds would be controlled using chemical, mechanical, or manual methods or through the use of livestock grazing. Under this alternative, however, public education and awareness of the effects that weeds have on native plant communities would be a key message for interpretation.

As under all alternatives, prescribed fire would be used. As under alternatives B and C, wildfires would be managed for multiple objectives. There would be a concerted effort to talk with the public about the role of fire on the landscape and garner support for strengthening the fire program. Similar to alternative B, we would pursue more funding for the protection of human safety following local, State, and National guidelines and strategies, but we would limit having to maintain facilities that could increase the Service's legal obligations on and off the site.

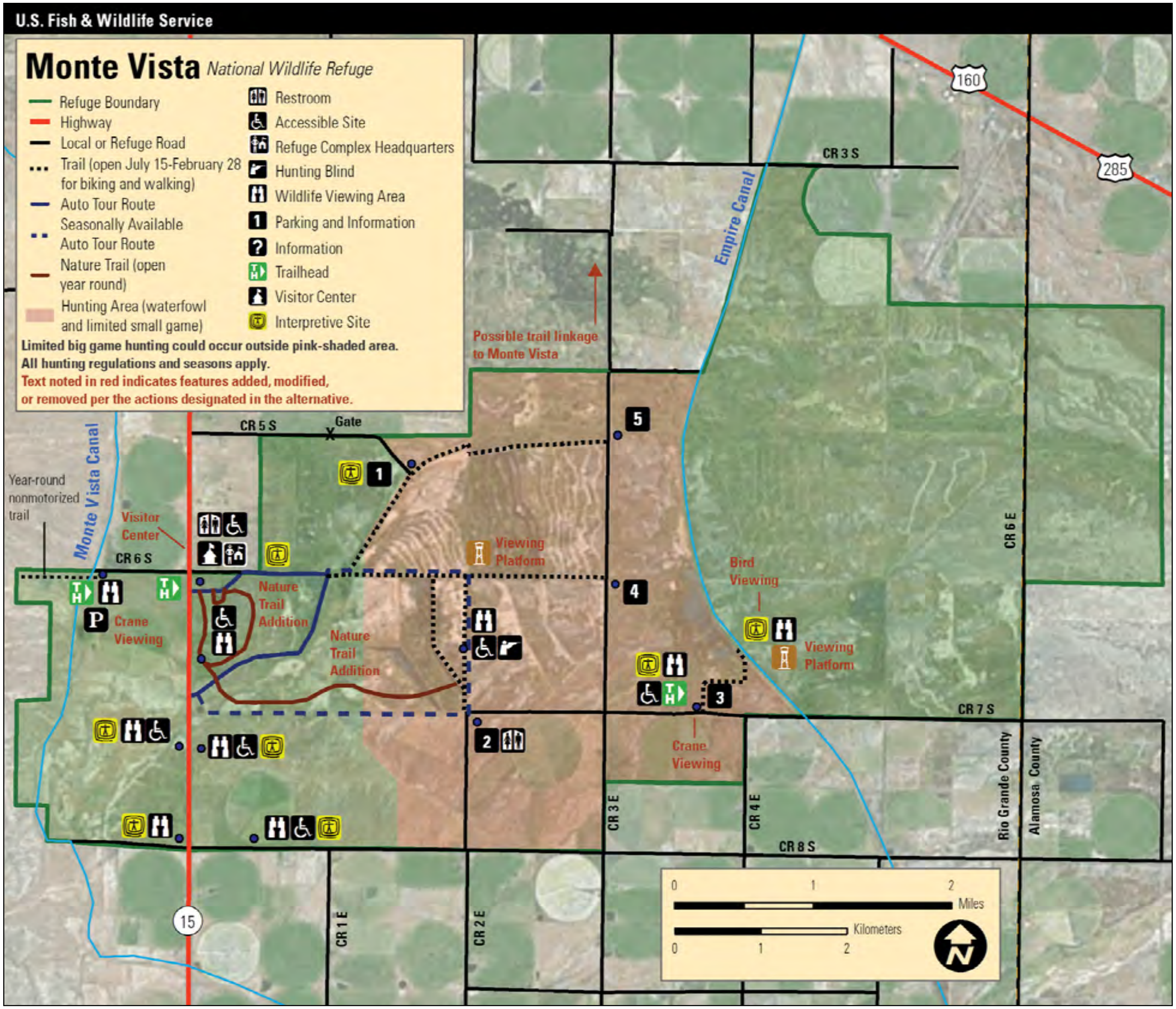

Figure 22. Map of alternative D for Monte Vista National Wildlife Refuge, Colorado.

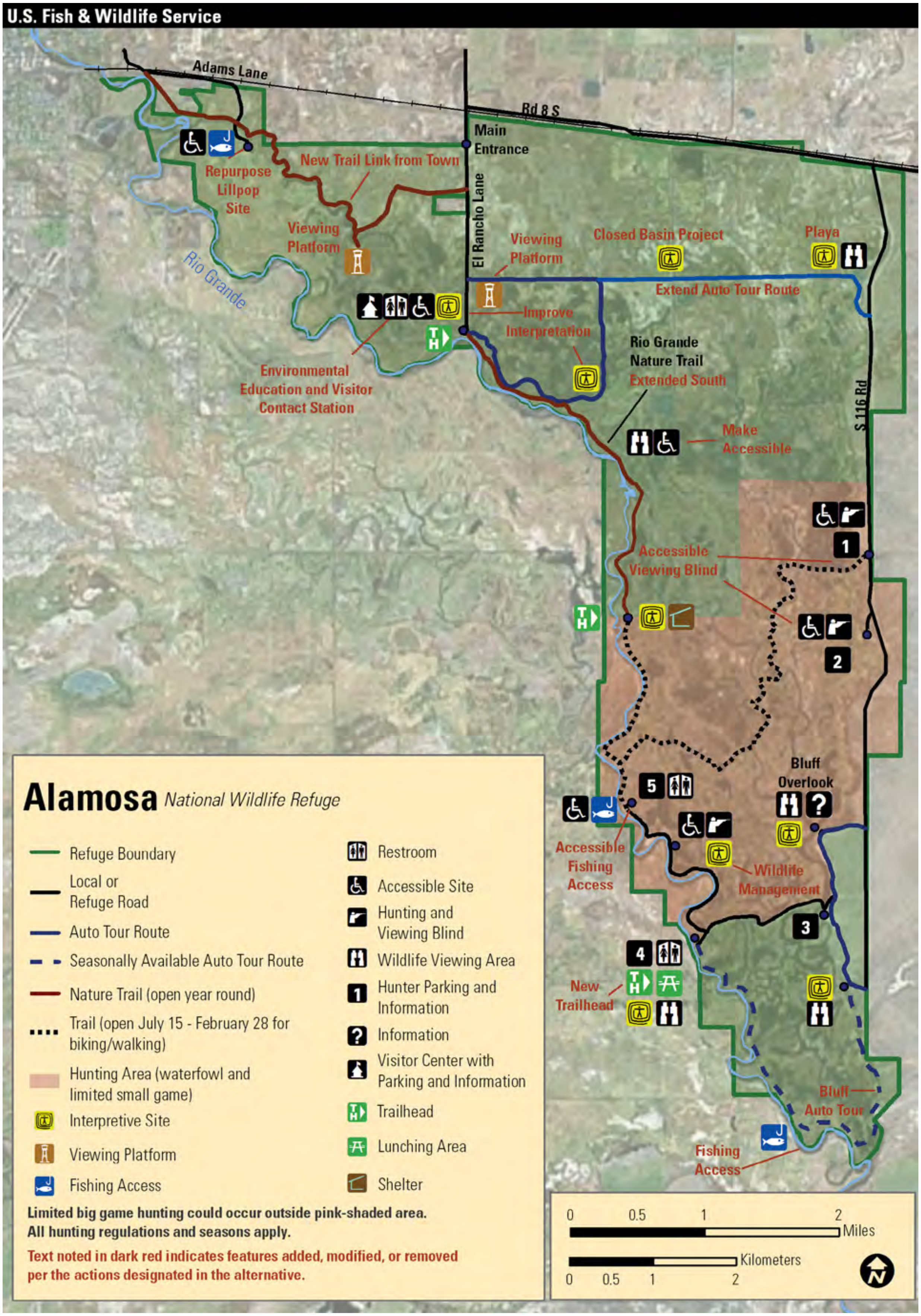

Figure 23. Map of alternative D for Alamosa National Wildlife Refuge, Colorado.

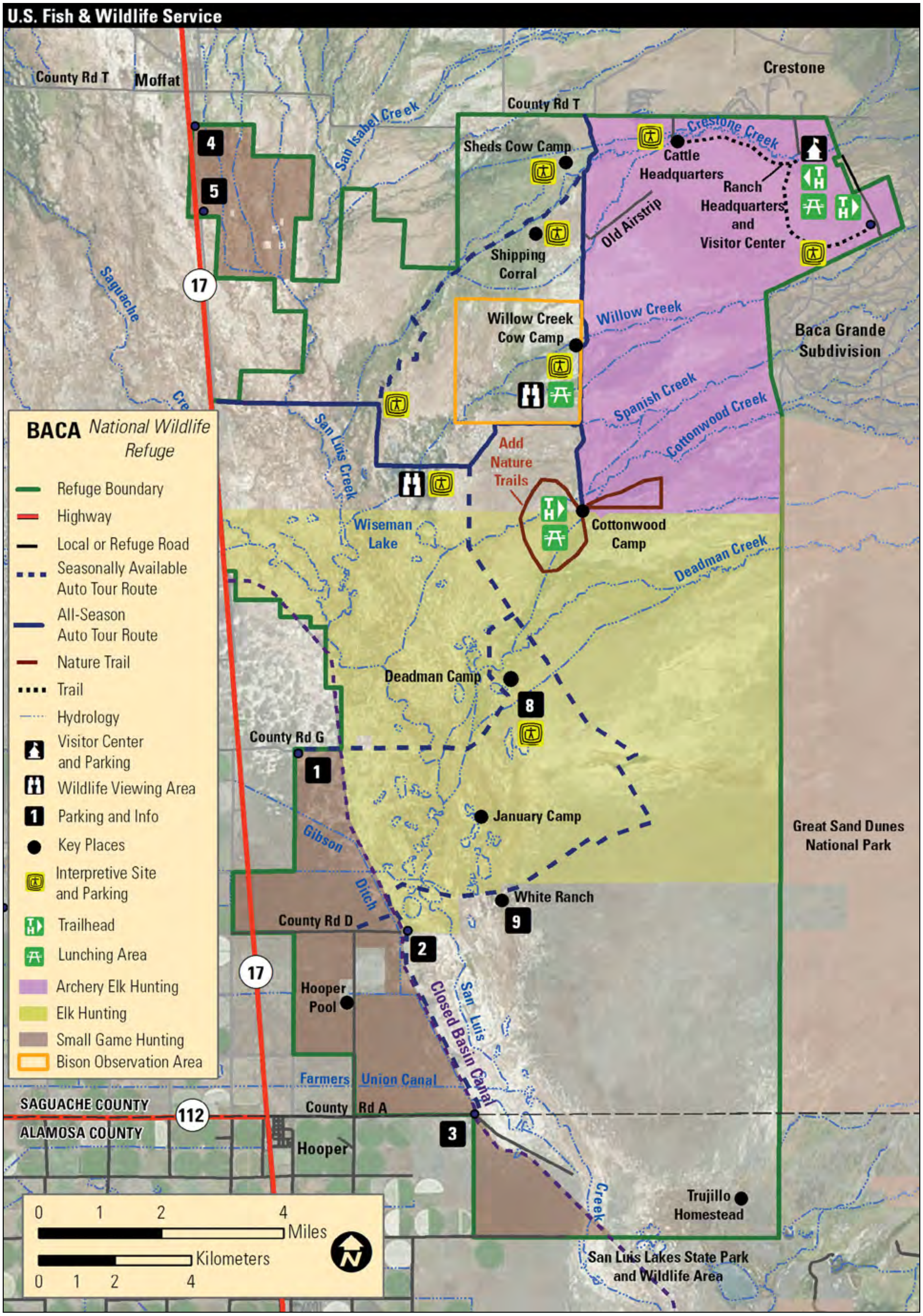

Figure 24. Map of alternative D for Baca National Wildlife Refuge, Colorado.

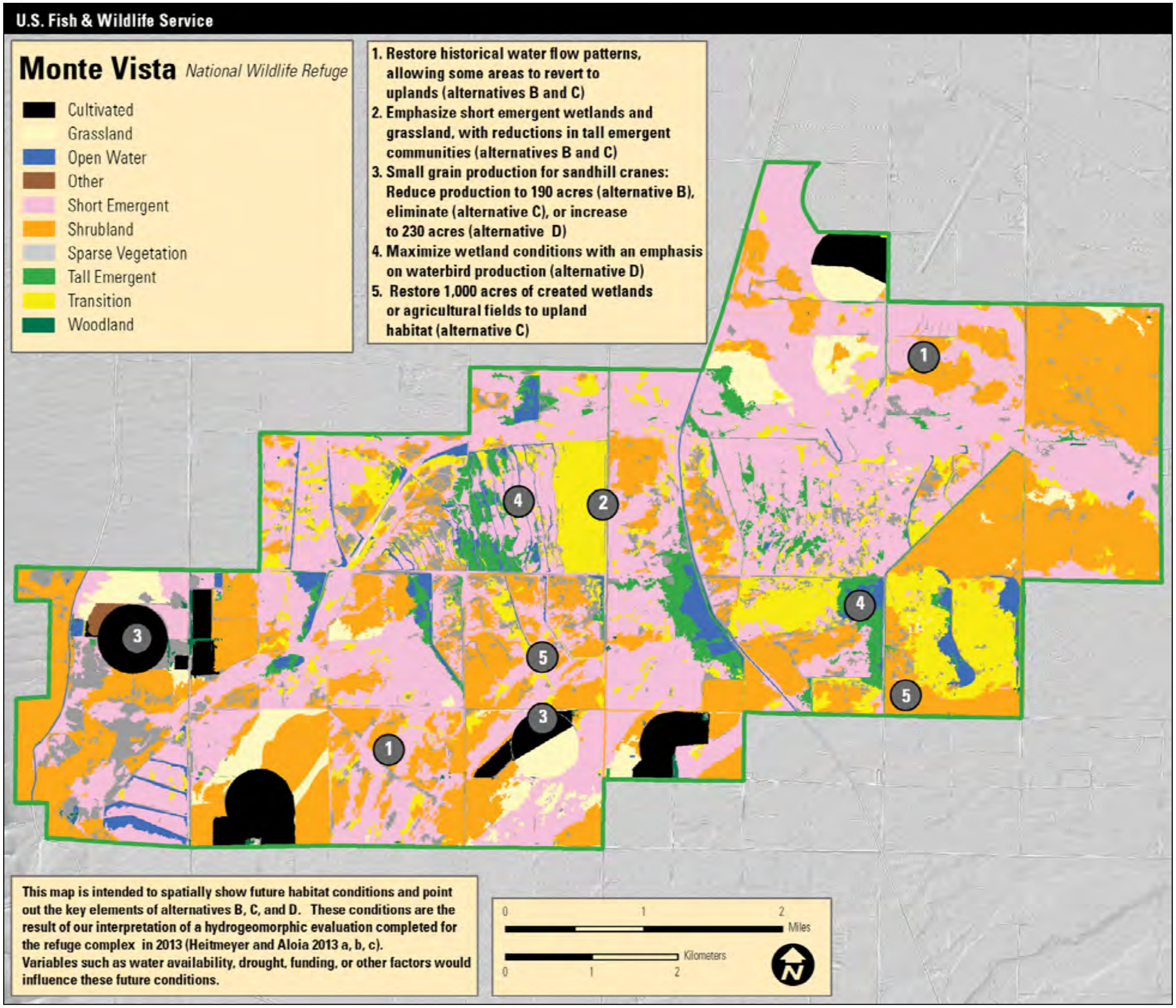

Figure 25. Map of alternatives B, C, and D of the potential future habitat conditions for Monte Vista Refuge, Colorado.

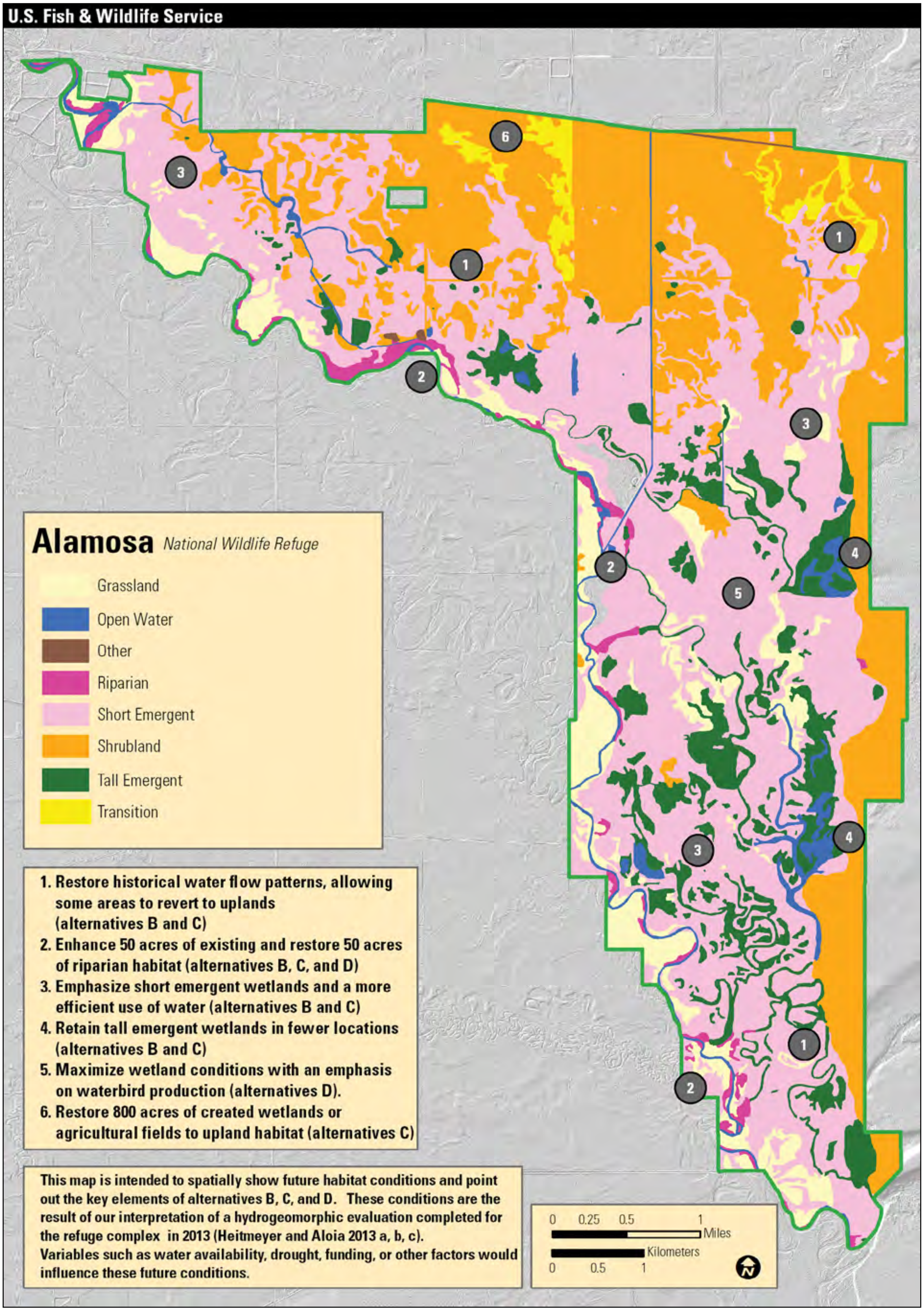

Figure 26. Map of alternatives B, C, and D potential future habitat conditions for Alamosa Refuge, Colorado.

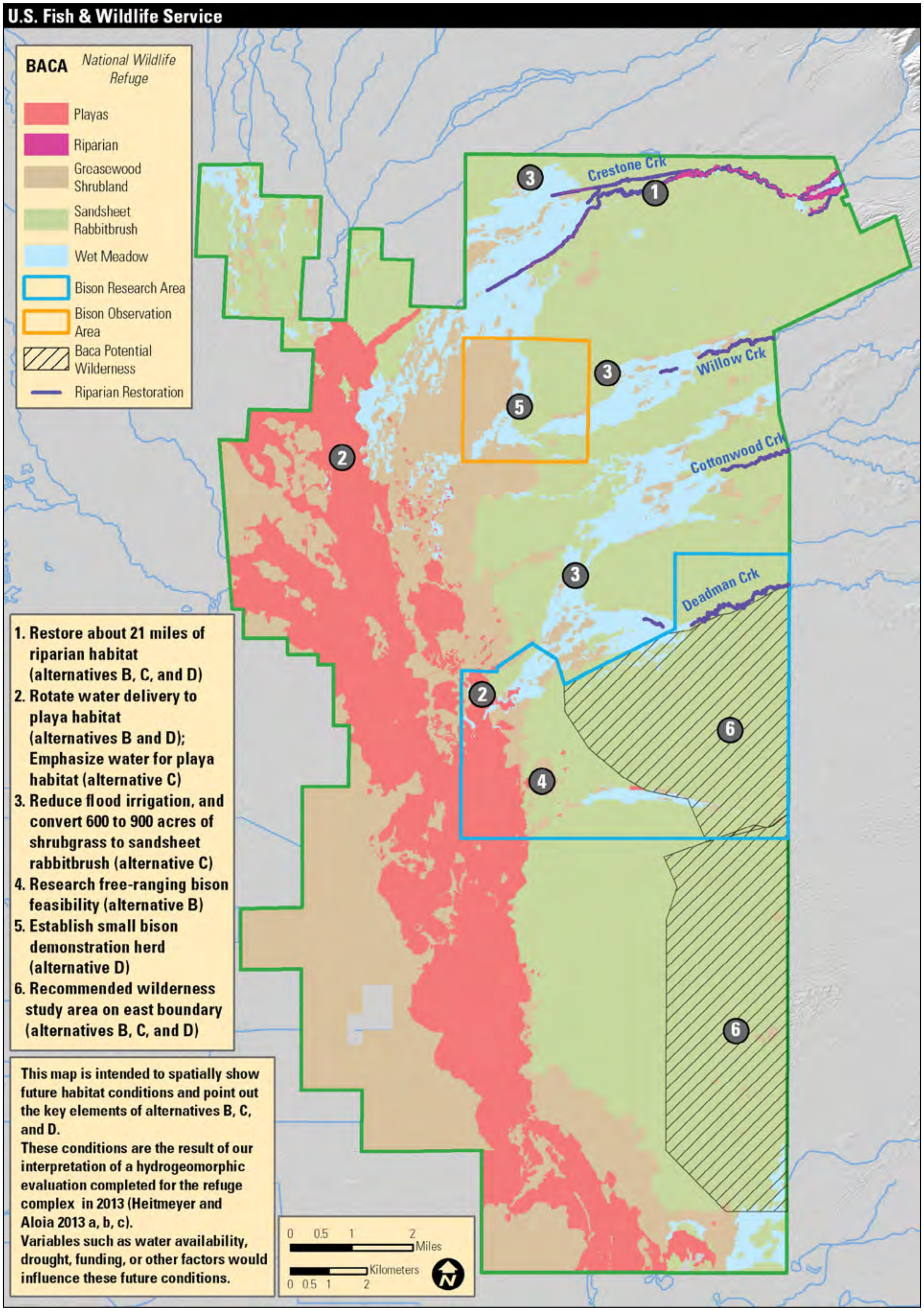

Figure 27. Map of alternatives B, C, and D potential future habitat conditions for Baca Refuge, Colorado.

Water Resources

We would manage water in a manner similar to alternative B except that more effort would be given to making sure there is water in specific areas or at a specific time to enhance wildlife viewing. The spatial distribution of water would be managed to make the visitor's experience richer. A high priority would be placed on maintaining operation of wells that provide important wildlife viewing habitat. All of our wells will be augmented and will comply with Colorado law. More water could also improve viewing opportunities. Ground water and surface water could be used to enhance areas used by sandhill cranes or provide more opportunities to see wildlife rather than merely providing for the life cycle needs of species less important to public uses. Similarly, we would improve infrastructure in areas that are highly valued by visitors to better facilitate wildlife observation. Water quality monitoring would be increased, and collaboration with a citizen scientist group or with schools or universities would be sought.

Visitor Services

This alternative would provide for the widest variety of compatible wildlife-dependent recreation (figures 22, 23, and 24). We would encourage and provide for big game hunting on the Baca Refuge, with public dispersal hunts on the Monte Vista and Alamosa Refuges and limited small game hunting opportunities for all, including youth hunts and considerations for accessibility. Similar to alternative B, access would be expanded for all refuges, including opening the Baca Refuge for public uses. More trails, viewing blinds, restrooms, parking areas, and access points would be constructed.

Although our responsibilities for habitat and wildlife management come first, we would also emphasize visitor experience when designing or locating visitor access or using existing infrastructure. With more staff and volunteers to support a wider range of compatible programs and facilities, we would increase interpretation and educational opportunities. Limited fishing access would be allowed on the Alamosa Refuge. Commercial uses, such as photography or art groups, would be considered. Public education and interpretation would highlight how visitor behavior can be modified to reduce wildlife disturbance.

Cultural Resources and Tribal Coordination

Actions would be similar to alternative B, except there would be a greater emphasis on using students or volunteers to survey areas with high potential for cultural resources. We would work with local and tribal educators to develop interpretive materials.

Partnerships and Refuge Complex Operations

Actions would be similar to alternative B, except we would pursue partnerships and funding for priority public uses as well as securing resources to protect, enhance, and interpret significant cultural resources.

Similar to alternative B, we would work with mineral developers to place resource extraction away from public use facilities. Management of any acquired fee-title lands would be consistent with habitat, wildlife, and public use objectives.

Research, Science, and Wilderness Review

Similar to alternative B, we would increase efforts to study habitats and wildlife, particularly with respect to understanding climate change and its effects on the resources of the San Luis Valley. How climate change affects the resources on the refuge complex would be incorporated into public use themes and messages.

Similar to alternative B, we would recommend wilderness protection for about 13,800 acres along the southeastern boundary of Baca Refuge (refer to figure E1 in appendix E).

3.8 Objectives and Strategies

As discussed in sections 3.1 and 3.3, the alternatives were developed from the planning identified in chapter 2. This section describes the specific objectives that would achieve the goals and meet the emphases of each alternative. Timeframes for the objectives are based on the assumption that implementation would begin immediately after the record of decision for the final CCP is issued and would continue over the following 15 years.

Objectives are concise statements of what needs to be achieved; how much, when, and where they would be achieved; and who would be responsible. To the extent possible, each objective has been developed to be SMART, or specific, measurable, achievable, results-oriented, and time-fixed (Adamacik et al. 2004)). Objectives provide the basis for identifying strategies and evaluating success in meeting the goals. The rationale for each objective describes how and why the objective's actions are important for achieving the associated goal in conjunction with the alternative's emphasis. Strategies are specific tools or techniques used to carry out the objectives.

Each goal title is listed below, followed by the associated objectives, rationale, and strategies for each of the four alternatives, A, B, C, and D. Where an objective or strategy is similar to or the same as, one for another alternative, this is noted and, for conciseness, is generally not repeated.

Organization of Objectives and Strategies

Objectives have been developed for each goal topic. Under each topic, there may be a number of subtopics or categories. For example, the habitat objectives are divided into the following areas: riparian, wetlands, playa wetlands, uplands, and transition areas. There are several specific categories related to wildlife management such as threatened and endangered species, focal bird species, greater sandhill cranes, and other species. Other subtopics are also included.

In large part, the habitat objectives and strategies under alternative A (the no-action alternative) are based on the management guidelines from the 2003 CCP for the Alamosa and Monte Vista Refuges and the 2005 conceptual management plan for the interim management of the Baca Refuge. Not all management actions under alternative A would remain the same, but the intent would be to manage the habitats within the refuge complex according to the overall direction set forth by these earlier planning efforts and within existing funding and resource levels. The earlier plan blended goals, objectives, and strategies, and we have attempted to separate these out to follow the current format for CCP development. In some places, we eliminated objectives from the 2003 CCP that were too vague or are not being implemented. The rationale statements were condensed from the earlier plan or are based on the direction given for implementing these plans.

Objectives for visitor services; partnerships; refuge operations; cultural resources and tribal coordination; and research, science, and wilderness review are discussed under their respective goal headings. While the objectives are separated by the vision and goals that we set for the project based on our scoping process, these topics are closely interrelated and should not be thought of as distinct, separate goals.

Habitat and Wildlife Resources

Habitat and wildlife resources on the refuge complex are diverse and varied. Our wildlife resources are a direct result of how we manage the various habitats. Important habitat types that are analyzed in this section are riparian habitats, various wetland habitats, playa wetlands (which are found predominantly on the Baca Refuge), and upland habitats. Although we generally discuss our management actions, such as grazing, invasive species control, haying, and mowing, under each habitat type, we have separated out fire management and have included specific objectives for this topic. For wildlife resources, we have identified specific objectives for threatened and endangered species, sandhill cranes, focal bird species, and bison. While all wildlife species are important, we believe that the objectives identified for each of these habitat types should help most of the species found on the refuge.

Riparian Habitat

Riparian habitat is a plant community consisting of water-loving trees or shrubs such as cottonwoods and willows and their associated understory that is contiguous to a river, stream, or drainage way. This type of habitat is found on the Alamosa and Baca Refuges. In fact, the name "Alamosa" refers to the once-extensive cottonwood groves in the region.

Riparian habitat provides nesting and foraging habitat for a large array of birds, including the endangered southwestern willow flycatcher. It is also one of the most degraded and limited habitat types in the western United States. Despite its limited availability, a disproportionate number of avian species depend on it (Knopf et al. 1988).

Objectives for Riparian Habitat, Alternative A

To the extent practical, under the no-action alternative, we would continue to follow the riparian objectives as described in our 2003 CCP and the conceptual management plan for the Baca Refuge.

Alamosa National Wildlife Refuge. Riparian Objective A1. On the Alamosa Refuge, we would continue to manage and enhance the Rio Grande corri-


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Along many sections of the creek corridors on Baca Refuge, the riparian habitat is in poor condition, having few mature plants with only small patches of willow or cottonwoods. We would restore these areas under alternatives B, C, and D.

dor and its tributaries to provide habitat for riverine, riparian-dependent, and other wetland species.

Riparian Objective A2. On the Alamosa Refuge, we would continue to provide dense multilayered native riparian vegetation such as willows and cottonwoods for breeding and migrating riparian species, particularly the southwestern willow flycatcher, yellow warbler, other songbirds, and other wildlife.

Rationale for Riparian A1–A2. Since Euro-American settlement in the San Luis Valley, many rivers and aquifers have been drastically altered (Siebenthal 1910; Natural Resources Committee Report 1938; Emery et al. 1973; San Luis Valley Water Conservancy District 2001). The Rio Grande upstream of the Alamosa Refuge has been extensively altered by diversion dams, the drilling of thousands of wells in the unconfined and confined aquifers, and other modifications (see chapter 4). It appears that these alterations have resulted in the degradation and reduction of riparian vegetation and wetlands along the entire Rio Grande corridor, including on the Alamosa Refuge, which lies within the river's floodplain and which used to regularly flood.

The Alamosa Refuge has a corridor of riparian habitat along the Rio Grande, as well as along old oxbows and canals within the interior of the refuge. A 2-year study in the 1990s documented more southwestern willow flycatcher territories (29) on the Alamosa Refuge than on any of the other 16 study sites outside of the refuge (Owen and Sogge 1997); however, in recent years there have been fewer than five territories found on the refuge, which is largely attributed to chronically low stream flows, reduced return flows from adjoining irrigated meadows, removal of the New ditch diversion dam, or all three factors.

Strategies for Riparian A1–A2:

- Continue to evaluate riparian habitats and species needs outside of the refuge complex boundaries through partnership programs and the Service's land protection planning program.

- Gather and interpret data on hydrology, riparian ecosystems, and historic riverine habitats along the Rio Grande to be used in deciding how, if, and when to begin riparian restoration. Investigate how best to use seasonal irrigation to restore riparian vegetation with our available water rights.

- Monitor and map noxious weeds such as tall whitetop, Russian knapweed, Canada thistle, and Eurasian water milfoil within the Rio Grande corridor and other riparian habitat and, if necessary, contain and reduce weed infestation.

- Monitor beaver and porcupine populations, and if porcupine populations are contributing to loss of willows along the Rio Grande on the Alamosa Refuge, control these populations if necessary.

Baca National Wildlife Refuge (2005 CMP). Riparian Objective A3. Continue to evaluate the condition of the riparian vegetation on the Baca Refuge and map areas of degradation and invasive species. Address obvious signs of degradation such as active downcutting of streambanks where feasible using existing levels of staff and funding (same as objectives B3, C3, and D3.).

Rationale for Riparian A3. There is a basic need to understand the current conditions of riparian areas on the Baca Refuge as well as the factors that are influencing those current conditions. This will give us the information needed to properly restore the condition and function of these systems.

Since the establishment of the Baca Refuge in 2005, we have been working to mitigate damage to riparian habitats and restore these communities. Haying and grazing by cattle occurred on areas of the Baca Refuge for over a century while it was managed as a ranch. Since the establishment of the national wildlife refuge, these practices have been removed from this sensitive habitat type as a component of the restoration process.

Many miles of fences have been installed and repaired in an effort to exclude cattle from riparian areas, with exceptions for maintaining water gaps (small bends in fencing that allow cattle access to a small portion of the stream for obtaining water). In addition, in areas along riparian areas where fencing is absent, grazing permittees are required to exclude their cattle (except for water gaps) with the use of electric fences.

Strategies for Riparian A3:

- Use corrective actions such as realigning streambanks, adding more fences, keeping cattle away from riparian habitats, and using dispersal techniques for elk.
- Monitor and control invasive species.
- Continue to gather baseline data on wildlife use in riparian areas.

Objectives for Riparian Habitat, Alternative B (Draft Proposed Action)

Under this alternative, we would restore the riparian community with native plants to provide quality habitat for birds, mammals, reptiles, and amphibians.

Alamosa National Wildlife Refuge. Riparian Objective B1. On the Alamosa Refuge, maintain and enhance a minimum of 50 acres of existing willow and cottonwood riparian habitat along the Rio Grande to help riparian species, with an emphasis on breeding songbirds (same as alternatives C and D).

Riparian Objective B2. By year 15, on off-channel sites, restore or establish a minimum of 50 acres of moderate to dense (>35 percent canopy cover) willow and cottonwood riparian habitat in locations where site conditions, including soil and available water (see figure 44 in chapter 4), would ensure long-term health, sustainability, and ecological function (same as alternatives C and D).

Baca National Wildlife Refuge. Riparian Objective B3. On the Baca Refuge prioritize addressing ongoing degradation and encroachment of invasive species in riparian areas (same as objectives A3, C3, D3).

Riparian Objective B4. On the Baca Refuge, by year 15, maintain existing reaches of healthy riparian habitats, which are defined as those with dense and multilayered woody vegetation. Restore the reaches of riparian habitat along about 21 miles of the Crestone, Willow, Cottonwood, and Deadman Creek drainages that are considered to be in poor condition with scattered mature plants and small patches of very small (< 2 ft. tall) young willows and narrowleaf cottonwoods. Restoration potential would be based on hydrology, seedling regeneration, and other factors (see figure 39 which shows flow paths and potential riparian restoration areas, chapter 4). On average, achieve >35 percent canopy cover of about 15–30 feet wide to help riparian species, with an emphasis on breeding songbirds (same as alternatives C and D) (see table 5, below, for the focal birds that use riparian habitats).

Riparian Objective B5. On the Baca Refuge, by year 15, achieve or maintain low browse levels by elk on >25 percent or 5 miles out of 21 miles of riparian corridors (same as alternatives C and D).

Riparian Objective B6. On the Baca Refuge maintain hydrologic conditions in creek channels and off-channel locations along 21 miles within the 4 creek drainages (same as alternatives C and D) (refer to figure 39, chapter 4).

Rationale for Riparian B1–B6. Same for alternatives C and D. Although riparian habitat occupies a small part of the land in western North America, it is disproportionately important for wildlife in general and birds in particular (Pase and Layser 1977, Thomas et al. 1979, Szaro 1980).

The restoration, enhancement, and maintenance of riparian habitat is one of our highest priorities for the refuge complex because of its importance to neotropical migratory songbirds and other wildlife species. Riparian habitat provides nesting habitat for the southwestern willow flycatcher, a federally endangered species, and enhancing riparian habitat on the refuges would contribute toward the recovery efforts for this species. Maintenance, enhancement, and restoration efforts would focus on providing a riparian community that has a diversity of plant species, age classes, and structure, and that is resilient and sustainable over the long term. This is essential for the survival of wildlife species that use these habitats for nesting, foraging, migration, and movement corridors (Shafroth et al. 2000, Scott et al. 2003, and Skagen et al. 2005).

There appears to be an overall lack of recruitment and survival of young willows and cottonwoods along the Rio Grande on the Alamosa Refuge. Although elk are present on the Alamosa Refuge, they do not appear to be a dominant influence on willow and cottonwood growth and survival. Instead, we and Keigley et al. (2009) surmise that hydrology, rather than browsing, is the driving factor in willow and cottonwood establishment, growth, and survival. On the Alamosa Refuge, our efforts would be aimed at restoring a minimum of 50 acres of riparian habitat along the river and another 50 acres in off-channel areas.

Riparian restoration and enhancement opportunities have been identified on about 21 miles of riparian habitat on four of the five creeks on the refuge. Selection of these areas is based on several criteria including hydrology, channel morphology, and existing and potential willow and cottonwood reproduction. We would also consider other in-stream modifications where appropriate, including inducing proper meandering, elevating the stream bed, and introducing cobble to provide substrate for phytoplankton growth for Rio Grande sucker and chub populations along Crestone Creek. We believe restoration of the riparian vegetation component would improve sinuosity, riffles, runs, pools and point bars; sediment transport and deposition; and the overall health of the active floodplain for these species.

One of the largest habitat constraints is the narrow width of the active floodplain where willow and cottonwood establishment and survival is possible. The dimensions, including width, length, and overall area, of woody riparian habitat are an important factor for many bird species (Darveau et al. 1993, Spackman and Hughes 1995). In general, the abundance of migratory birds is higher in the interior of riparian habitats and species richness increases with the area or width of those habitats (Szaro and Jakle 1985, Stauffer and Best 1980, Dobkin and Wilcox 1986, Keller et al. 1993, Freemark et al. 1995). Because of the morphological constraints such as the narrow floodplain, we would restore riparian habitat along all the creeks, achieving the greatest width possible (minimum 15–30 feet wide on average), thereby providing habitat for many edge and interior bird species, while realizing that some area-sensitive and interior species may not find this configuration suitable.

Strategies for Riparian B1–B6: Same for alternatives C and D.

- Evaluate levels of ungulate, beaver, and porcupine browsing within willow and cottonwood habitats at least once every 3 years.
- Develop thresholds that would trigger increased management levels to prevent or reduce browse. Use fencing to exclude browsing animals and, in cooperation with the CPW, develop additional strategies including elk dispersal and harvest as well as the temporary control of beaver and porcupine.
- If willow and cottonwood communities become healthy enough, consider allowing beaver populations to naturally help with creek restoration and enhancement.
- By year 3 of the CCP, establish a hydrologic monitoring plan and install ground water measurement devices.
- Within 3 years, begin a vegetation monitoring plan to assess the influence of hydrologic conditions on willow and cottonwood growth and survival.
- Plant willows and cottonwoods in suitable locations.
- Manage hydrologic conditions in creek channels and off-channel locations to the greatest extent possible to promote the regeneration, growth, and survival of willows and cottonwoods.
- Ensure that the timing, duration, frequency, and location of haying, mowing, and grazing activities do not negatively affect riparian areas.
- Employ wildland fire management actions (wildfire suppression and prescribed fire) to

protect, enhance, or promote the regeneration and growth of riparian vegetation.

- Improve creek morphology to manage erosion and sediment transport and stop further channel incising.
- Monitor wildlife to document changes in wildlife use and possible correlations to changes in habitat quantity and quality.
- On the Baca Refuge, evaluate and monitor the native fish community in Crestone Creek and Willow Creek to determine how habitat conditions affect reproduction and survival (refer to objectives for Rio Grande suckers below).
- Manage grazing and browsing by all domestic ungulates such as cattle, sheep, and bison; and only allow grazing where there is an expected improvement in riparian vegetation and soils.

Objectives for Riparian Habitat, Alternative C

Because of the importance of riparian areas to the refuge, the objectives would be the same as or very similar to those for alternative B.

Alamosa National Wildlife Refuge Riparian Objective C1–C2. Same as B.

Rationale for Riparian C1–C2. Same as B.

Strategies for Riparian C1–C2. Same as B.

Baca National Wildlife Refuge. Riparian Objective C3–C6. Same as B.

Rationale for Riparian C3–C6. Same as B.

Strategies for Riparian C3–C6. Same as B.

Objectives for Riparian Habitat, Alternative D

Because of the importance of riparian areas to the refuge, the objectives would be the same as or very similar to those for alternative B.

Alamosa National Wildlife Refuge Riparian Objective D1–D2. Same as alternative B.

Baca National Wildlife Refuge. Riparian Objective D3–D4. Same as B except differing use patterns.

Rationale for Riparian D3–D4. Same as B.

Strategies for Riparian D3–D4. Same as B and C except:

- Locate bison pastures near public access points. Use conservative stocking rates and use frequent rotation to ensure sustainability. Bison grazing would not be allowed in riparian areas.

Wetlands

In the 2003 CCP for the Monte Vista and Alamosa Refuges, wetlands were broken out into several subcategories including short emergent and tall emergent. Short emergent species include spike rush, sedges, and Baltic rush; tall emergent species include phragmites, cattail, and bulrush. Under the action alternatives (B, C, and D) below, where practical we combined or summarized the various subcategories, except for on the Baca Refuge, where only objectives for short emergent wetlands are discussed. Existing vegetation classes for the three refuges are shown in figures 43, 44, and 45 in section 4.3.1 in chapter 4.

Objectives for Wetlands, Alternative A

Alamosa and Monte Vista National Wildlife Refuges. Short Emergent Objective A1. Shallowly flood 25 percent of the existing 5,426 acres of short-emergent plant community on the Alamosa Refuge and 6,667 acres on the Monte Vista Refuge during February and March to provide food and cover for migratory and breeding birds including sandhill cranes, Canada geese, and other waterfowl.

Short Emergent Objective A2. Shallowly flood 50 percent of the existing shallow short-emergent plant community on the refuge complex from April through mid-June to support plant, invertebrate, and vertebrate food sources for migrating and breeding ducks, shorebirds, waders, rails, and Canada geese.

Short Emergent Objective A3. Decrease the amount of shallow water to 30 percent of the existing acres of short-emergent vegetation from mid-June through mid-July to limit the encroachment of tall-emergent plants while continuing to provide cover and food for waterfowl broods, shorebirds, waders, rails, and others.

Short Emergent Objective A4. Maintain the health and manage species composition of short-emergent plant communities by decreasing shallowly flooded areas to 26 percent of the existing acres of short-emergent vegetation from mid-July to mid-September while continuing to provide habitat for foraging rail and duck broods, young white-faced ibis, migrating shorebirds, and post-breeding waterfowl.

Short Emergent Objective A5. Provide habitat for nesting mallard, gadwall, cinnamon teal, short-eared owl, northern harrier, marsh-nesting passerines,

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Cinnamon teals are focal bird species that breed on Alamosa and Monte Vista Refuges.

rails, and small mammal populations by providing cover of 12 inches or more and excluding tall whitetop on 20 percent of the existing acres of short-emergent vegetation in April and May.

Short Emergent Objective A6. Provide habitat for nesting gadwall, northern pintail, northern shoveler, Wilson's snipe, Wilson's phalarope, and short-eared owl populations by providing a moderate cover of 6 to 12 inches on 40 percent of the existing acres of short-emergent vegetation from May to mid-June.

Short Emergent Objective A7. Provide habitat for nesting Savannah sparrow, vesper sparrow, Wilson's snipe, Wilson's phalarope, and northern shoveler populations by providing a sparse cover of 6 inches or less on 15 percent of the existing acres of short-emergent vegetation from April through July.

Short Emergent Objective A8. Reduce the area of short-emergent habitat infested by noxious weeds such as tall whitetop and Canada thistle by 20 percent.

Rationale for Short Emergent A1–A8. Dense short-emergent vegetation provides cover and food for breeding, wintering, and foraging birds and other wildlife species. Short-emergent vegetation occurs throughout the San Luis Valley on private lands as well as State and federally owned wildlife areas. It is associated with high water tables along streams and is a result of irrigation practices. Few places in the San Luis Valley can be managed for production of dense, un-harvested stands of short-emergent vegetation to help wildlife. Most short-emergent vegetation on private land is managed for the production of hay and forage for cattle. As a result, most of the vegetation on private land is too short for most ground-nesting birds, but it often provides good foraging habitat for many bird species. Land owned by the State of Colorado, the Federal government (primarily the Service), nongovernmental organizations, and several private landowners has been dedicated to the production of this habitat type and condition.

Strategies for Short Emergent A1–A8:

- When available, use recharge water, as designated by the Colorado Division of Water Resources, to shallowly flood 5 percent or more of the existing short-emergent vegetation in November and December to recharge ground water supplies and to saturate the soil for more effective irrigation of these areas the following spring.
- Maintain existing water rights. Allow for flexibility in water application and management.
- Develop protocols to better monitor water application and resulting effects on habitat, including vegetation distribution and succession, nutrient cycling, invertebrate production, noxious weed distribution, and other factors.
- Maintain and improve water management infrastructure.
- Develop a protocol to quantify the amount and type of wetland vegetation on the refuge complex and assist others with similar efforts on a valley-wide scale.
- Map the distribution of weeds on the refuge complex, and continue to investigate weed control methods including integrated pest management strategies. Monitor the success of weed control efforts.
- Use management treatments such as flooding, prescribed grazing, haying, fire, and herbicides to promote native plant communities and reduce and control invasive plant species.

Tall Emergent Objective A1. Provide habitat for migrating and breeding waterbirds and passerines by flooding 1,561 acres of existing tall-emergent vegetation on the Alamosa Refuge and 600 acres on the Monte Vista Refuge beginning in mid-February.

Tall Emergent Objective A2. Maintain islands of bulrush in non-fluctuating reaches of open water from May to mid-July for colonial-nesting waterbirds such as white-faced ibis and black-crowned night-heron.

Tall Emergent Objective A3. Provide shallow water (less than 12 inches) within tall-emergent wetlands for foraging waterfowl broods; post-breeding shorebirds, waders, coots, rails, and waterfowl; molting waterfowl; and migrating shorebirds by drawing down water from mid-July to mid-September.

Tall Emergent Objective A4. Provide habitat for mating, nesting, brood rearing, molting, and post-breeding waterbirds, such as colonial nesters, by maintaining a mosaic of cover and water interspersion (half cattail and bulrush and half open water) on 60 percent of the existing acres of tall-emergent vegetation on the complex.

Tall Emergent Objective A5. Develop one additional rookery area of tall-emergent vegetation of adequate size for colonial-nesting waterbirds.

Tall Emergent Objective A6. Investigate and begin control methods for monocultural phragmites stands on the Alamosa Refuge.

Rationale for Tall Emergent A1–A6. These objectives came from goal 4 of the 2003 CCP, which was to provide tall-emergent vegetation and other suitable habitat conditions for breeding waterbirds and marsh passerines on the refuge complex. Tall-emergent vegetation with favorable nesting conditions for species of management concern, such as white-faced ibis, American bittern, and black tern as well as other colonial waterbirds and marsh passerines, is provided only on some Federal, State, and private lands in the San Luis Valley. The refuge complex can manage this habitat type to provide stable water conditions, proximity to short-emergent foraging habitat, and protection from disturbance. This habitat type on the Monte Vista Refuge supports the second-largest colony of colonial-nesting waterbirds in the State (Refuge files, Ron Ryder, personal communication, February 1999).

Strategies for Tall Emergent A1–A6:

- Maintain the current annual water regime in Parker Pond and Bowen Pond. Once colonial nesting is begun, water will be held at static levels.
- Continue to evaluate the protection needs of other colonial waterbird nesting areas in the San Luis Valley by monitoring and evaluating suitable property and collaborating with our partners.
- Investigate the amount of tall emergent habitat that is needed to support the goals of the San Luis Valley Water Bird Plan, Intermountain West Water Bird Plan, and the North American Water Bird Conservation Plan.
- Assist in collecting data to test assumptions about the amount and distribution of this habitat type required in the San Luis Valley.

Baca National Wildlife Refuge (2005 CMP). Short Emergent Objective A9. Continue to monitor overall grass, sedge, and rush health in this habitat type. Where obvious degradation is occurring, such as through encroachment of invasive species, take corrective action.

Rationale for Short Emergent A9. One of the unique features of the short-emergent habitat type on the Baca Refuge is that invasive plants are sparse across most of the refuge. We believe that this is largely attributable to relatively consistent management practices on the property over the last 120+ years. These management practices include fairly stable patterns of surface water irrigation, haying, and grazing. To a large extent, historical irrigation practices have created this wetland plant community. Short-emergent habitat on the refuge is irrigated using a relatively simple set of diversion structures and ditches diverting from all the creeks crossing the refuge. In addition to the creeks, several wells are used for irrigation. Irrigation generally begins in late spring with the onset of increased flows from melting snow and continues into the summer (FWS 2005). We have found that when areas are repeatedly irrigated and then left idle for several seasons, decadent plant material accumulates and regeneration of native plants is inhibited. We have found that if idle conditions continue, noxious weeds will typically establish themselves and out-compete native plant species. Since the acquisition of Baca Refuge in 2005, our management of the wet meadow habitat type has been similar to historic management practices on the property. Our primary management strategy has been to stop the spread and new establishment of invasive weeds within this habitat type. Some problem areas with invasive plants do occur on the refuge, and efforts continue to reduce and control the spread of weeds in these areas.

Strategies for Short Emergent A9:

- Maintain existing water rights to allow for flexibility in water application and management.

- Maintain and improve water management infrastructure.
- Continue to investigate weed control methods, including integrated pest management strategies, and monitor weed control efforts.
- Use various management techniques to control invasive plants, including combinations of prescribed fire, grazing, chemical applications, and mowing and haying.

Short Emergent Objective A10. Continue collecting baseline information on wildlife and plants, and researching effects of management practices on native wildlife species with an emphasis on nesting birds.

Rationale for Short Emergent A10. Since the Baca Refuge was established fairly recently, a baseline inventory of native and invasive species is still being collected, and this effort would be continued. We have little information about the potential value of this habitat type for native wildlife species, especially for wetland bird species. Depending on plant structure and density as well as on water depth and duration, wet meadows may offer tremendous foraging and nesting opportunities for a variety of wetland birds, including many species of waterfowl, sora, Virginia rail, white-faced ibis, American avocet, Wilson's snipe, and Wilson's phalarope. Wet meadows also provide habitat for a variety of rare amphibian species such as northern leopard frog and Plains spadefoot toad. Previous research conducted at the Baca Refuge provides important information about associations between habitat conditions and native bird species (Murphy 2009; Dieni 2010a, 2010b). In 2008, Murphy (2009) conducted a baseline inventory of breeding bird presence in short-emergent habitat. Dieni (2010a) evaluated bird species composition and use in wet meadows and associated habitats during the post-breeding period and fall migration. Dieni (2010b) also conducted research on the effects of haying on habitat structure and the breeding bird community. During the summers from 2011 to 2013, refuge researchers have conducted research on the associated effects of various management treatments such as fire, grazing, and haying on nesting birds. However, these short-term studies are insufficient for providing managers with enough information to guide future best management practices for this habitat type, so more studies are needed.

Strategies for Short Emergent A10:

- Rely on seasonal staff, interns, or volunteers for continued research efforts.
- Continue to study effects of management on the plant community and wildlife species.

Objectives for Wetlands, Alternative B (Draft Proposed Action)

Our overall goal for wetlands is to provide and manage natural and constructed wetland habitat; mimic to the greatest extent possible natural hydrologic and disturbance regimes; promote sustainable native ecological communities; and provide habitat for waterfowl, shorebirds, rails, wading birds, and other wetland-associated wildlife. These objectives consider various habitat types found on the refuges; their current and future potential availability and condition; surrounding land-use practices; the amount of habitat loss and degradation that has occurred for various habitat types across the landscape (both locally and regionally); drought and availability of irrigation water; and a review of the needs of wildlife species. For declining species, we examined the limiting factors that are causing their declines. Figures 25 and 26 show the potential future habitat conditions on the Alamosa and Monte Vista Refuges, and figure 27 shows potential future habitat conditions on the Baca Refuge. Variables such as water availability, drought, funding, and other factors could alter the acreage of each habitat type. The acreage identified in the objectives below reflects the future habitat conditions.

Alamosa and Monte Vista National Wildlife Refuges. Monte Vista Wetland Objective B1. From mid-February through March (spring migration), depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 25 percent (+/- 10 percent) of the 2,221 estimated maximum potential acres of short-emergent habitat to depths of <15 inches to provide foraging and pairing habitat for waterfowl as well as roosting habitat for sandhill cranes. Tolerance level of invasive plant species is ≤10 percent.
- Flood 25 percent (+/- 10 percent) of the 544 estimated maximum potential acres of tall-emergent habitat to provide foraging habitat for waterfowl.

Monte Vista Wetland Objective B2. From April through mid-June (nesting) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 50 percent (+/- 10 percent) of the 2,221 estimated maximum potential acres of short-emergent habitat to depths of <15 inches to provide foraging and nesting habitat for waterfowl, shorebirds, wading birds, and rails. Tolerance level of invasive plant species is ≤15 percent (densities exceed more than 20 stems per meter^2).

- Flood 60 percent (+/- 10 percent) of the 544 estimated maximum potential acres of tall-emergent habitat to provide habitat for nesting waterbirds such as colonial-nesting white-faced ibis, black-crowned night-herons, and snowy egrets as well as grebes and black terns.

- Flood 25 percent (+/- 10 percent) of the 1,095 estimated maximum potential acres of habitat dominated by inland saltgrass to depths of <3 inches for short durations (<60 days) to provide foraging and nesting areas for shorebirds.

Monte Vista Wetland Objective B3. From mid-June through August (brood rearing) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood about 250 (+/- 10 percent) acres annually of open water and tall-emergent habitat to provide brood rearing areas for waterfowl and waterbirds throughout the refuge.

Monte Vista Wetland Objective B4. In September and October (fall migration) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 25 percent (+/- 10 percent) of the 2,221 estimated maximum potential acres of short-emergent habitat to depths <15 inches to provide foraging habitat for waterfowl as well as roosting habitat for sandhill cranes. Tolerance level of invasive plant species is ≤10 percent.

- Flood 25 percent (+/- 10 percent) of the 544 estimated maximum potential acres of tall-emergent habitat to provide foraging and pairing habitat for waterfowl.

Alamosa Wetland Objective B5. From mid-February through March (spring migration), provide water to accomplish the following:

- 25 percent (+/- 10 percent) of the 5,528 estimated maximum potential acres of short-emergent habitat flooded to depths of <15 inches to provide foraging and pairing habitat for waterfowl. Tolerance level of invasive plant species is ≤ 10 percent.

- 25 percent (+/- 10 percent) of the 1,109 estimated maximum potential acres of tall-emergent habitat to provide foraging and pairing habitat for waterfowl.

Alamosa Wetland Objective B6. From April through mid-June (nesting) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 50 percent (+/- 10 percent) of the 5,528 estimated maximum potential acres of short-emergent habitat to depths of <15 inches to provide foraging and nesting habitat for waterfowl, shorebirds, wading birds, and rails. Tolerance level for invasive plant species is ≤10 percent.

- Flood 60 percent (+/- 10 percent) of the 1,109 estimated maximum potential acres of tall-emergent habitat to provide habitat for nesting waterbirds.

- Flood 25 percent (+/- 10 percent) of the 216 estimated maximum potential acres of transition habitat (dominated by inland saltgrass) to depths <3 inches for short durations (<60 days) to provide foraging and nesting areas for shorebirds.

Alamosa Wetland Objective B7. From mid-June through August (brood rearing) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood about 300 acres (+/- 10 percent) annually of open water and tall-emergent habitat to provide brood-rearing areas for waterfowl and waterbirds.

Alamosa Wetland Objective B8. In September and October (fall migration) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 25 percent (+/- 10 percent) of the 5,528 estimated maximum potential acres of short-emergent habitat to depths of <15 inches to provide foraging habitat for waterfowl. Tolerance level for invasive plant species is ≤10 percent.

- Flood 25 percent (+/- 10 percent) of the 1,109 estimated maximum potential acres of tall-emergent habitat to provide foraging habitat for waterfowl.

Rationale for Wetlands B1–B8. The refuge complex supports a diversity of wetland types, including ephemeral wetlands interspersed with native shrublands, seasonal wetlands, semipermanent wetlands such as oxbows and abandoned channels along the Rio Grande, and created wetlands that can be managed to mimic different wetland types. Collectively, these wetland areas support a range of habitat types, including open water, tall emergent, short emergent, saltgrass, and bare mudflat. Each of these habitats provides resources such as invertebrates, plant foods, and cover in unique combinations that are important for meeting the needs of focal species. Maintaining and restoring the integrity, productivity, function, and long-term sustainability of these wetland types on the refuges is of principal importance.

Hydrology is the single greatest driver of wetland function, including nutrient cycling and plant community dynamics (Mitsch and Gosselink 2003, Euliss et al. 2004, Laubhan et al. 2012). Wetland communities on the refuges are influenced greatly by the timing and availability of surface water. Under natural conditions, hydrology was highly dynamic, varying seasonally and annually, with most water available during spring and early summer from snowmelt and runoff from the surrounding mountains. Most wetlands have typically dried up by fall in most years, although deeper wetland depressions may have had semipermanent water regimes during wet years or when ground water levels were high. As a result, native wildlife species are adapted to and depend on the resources provided by wetland habitats influenced by a dynamic hydrologic regime. Habitat-based objectives and strategies therefore focus on maintaining or mimicking natural hydrologic regimes, both spatially and temporally, with the assumption that if the integrity of the system is maintained or restored, the key resources required by wildlife species will be provided.

Significant changes to the land surface and hydrology have occurred on all three refuges, both before and after refuge establishment. The most extensive changes have been on the Monte Vista and Alamosa Refuges, where water and habitat management activities have emphasized waterfowl production and associated hunting opportunities. After long-term monitoring of nesting waterfowl on the Monte Vista Refuge revealed that certain areas, primarily those characterized by dense stands of Baltic rush, exhibited extremely high densities of nesting waterfowl (Gilbert et al. 1996), significant attempts were made to create these conditions elsewhere across the Monte Vista and Alamosa Refuges. Numerous levees and ditches were constructed and water control and diversion structures were installed with the goal of maximizing the amount of flooded acres to create dense stands of Baltic rush. However, much of this occurred irrespective of soil types and other abiotic considerations (FWS 1962) and, as a consequence, plant communities on the refuges were greatly degraded.

We believe that the water management regime that has occurred over the last 30 years on the Monte Vista and Alamosa Refuges cannot continue to maintain the integrity, productivity, and function of many of the wetland habitats. This is especially true given the continued and dynamic climatic variations; anticipated changes in Colorado State water law (ground water rules and regulations) that may affect the future volume and timing of water availability on the refuges; and declining flows in the Rio Grande (Rich Roberts, personal communication with Pete Striffler, February 13, 2013) resulting from drought, depletions, and a changing climate. As a result, many wetland habitats are not likely to continue to provide the resources necessary to support migrating and nesting populations of waterfowl.

In order to ensure that the wetland habitats on the refuges are ecologically resilient to climatic and hydrologic changes, the proposed objectives and strategies are intended to maintain the integrity and persistence of all wetland types and to provide food and cover for a diversity of waterfowl, waterbirds, and other wildlife species (refer to figures 25 and 26 which show the potential future habitat conditions under alternative B). While this approach involves the restoration of natural hydrologic patterns and corresponding native vegetation types in some areas, not all artificially created wetland habitats will be returned to historical conditions. Many of these areas will be artificially maintained because these created habitats provide resources such as food and cover that are required by a wide array of wildlife species. These areas will be continually evaluated to determine their long-term sustainability and productivity. However, other areas may require modifications to current infrastructure to facilitate water management that best mimics natural hydrologic regimes.

Invasive weed control in wetland habitats continues to be a top priority for the refuge complex. Little information exists about the effects of low densities of invasive weeds across large wetland complexes. While more research is needed, we believe that once infestations cover more than 15 percent of a wetland basin or densities exceed 20 stems/meter^2, detrimental effects are most likely occurring to wetland habitat quality. At these densities, we would aggressively control weed infestations using a combination of tools such as prescriptive grazing; prescribed fire; haying and mowing; and herbicide application.

Strategies for Wetlands B1–B8:

- Maintain existing surface and ground water rights.
- Continue to evaluate water management infrastructure needs to facilitate water management that mimics, to the greatest extent possible, natural hydrologic conditions.
- Following evaluation, alter or install water management infrastructure as needed to facilitate the delivery and maintenance of waterflow in natural flow paths and created wetlands.
- Following evaluation, change obstructions such as roads, ditches, and levees that significantly alter surface and subsurface waterflows.
- Manage hydrology to restore native shrublands and saltgrass habitats in suitable locations.
- Manage the timing, duration, and volume of water in natural flow paths and created wetlands that mimics, to the greatest extent possible, natural hydrologic regimes to restore and maintain wetland function, productivity, and sustainability. Use information available on life cycle requirements of focal species to guide management decisions.
- In addition to managing hydrology, use a combination of treatments such as using prescribed fire, grazing, and haying to provide a diversity of vegetative structure for foraging, roosting, and nesting birds.
- Use management treatments such as seasonal flooding, prescribed fire, prescribed grazing and haying, and herbicides to promote native plant communities and reduce and control invasive plant species.
- Continue to provide wetland mitigation for the Closed Basin Project following the Fish and Wildlife Coordination Act Report and subsequent agreements (Coordination Act). Evaluate the use of mitigation water in other wetland areas to meet wildlife management objectives while complying with the Coordination Act.

Baca National Wildlife Refuge. Short Emergent Objective B1. Use flood and sub-irrigation on 70–80 percent of irrigable acreage, of which about 8,329 acres fluctuates annually based on snowpack levels in the Sangre de Cristo Mountains, to maintain and improve graminoid (grasses) health. Where degradation is occurring or is anticipated to occur such as from invasive species, low live-to-dead ratios, or low stem density levels, take proactive or corrective actions.

Rationale for Short Emergent B1. Many changes have occurred to land and water management in the San Luis Valley and at the Baca Refuge during the last century. The original Baca Land Grant Number 4 that now encompasses much of the refuge had its first water right decreed by the State in 1869, followed by dozens of decreed water rights associated with the principal creeks. These water rights were transferred to the Service when the Baca Refuge was established in 2003. As water rights were established on this property and others around the valley, significant hydrological changes occurred after the installation of diversions, ditches, water control structures, and wells, which allowed for the artificial expansion of hay meadows, grasslands, and the short-emergent habitat type overall. However, with the downtrend in water availability, refuge resources are now invested in maximizing the efficiency of refuge irrigation practices. Therefore, because refuge managers are also using scarce surface water to irrigate other habitat types such as riparian habitat and playa wetlands, attempting to maximize short-emergent vegetation is more difficult.

One of our goals is to focus our available refuge resources on applying irrigation water effectively and efficiently to areas where short-emergent wetlands occurred historically. A hydrogeomorphic analysis that was completed for the Baca Refuge in 2013 provides a context to understand the physical and biological formation, features, and ecological processes of lands on the refuge and in the surrounding region (Heitmeyer and Aloia 2013b). This research may help refuge managers in their efforts to restore natural patterns and processes of this short-emergent habitat while continuing to irrigate other wetland habitat types such as riparian habitat and playa wetlands. Figure 27 shows what the potential future habitat conditions could like under alternative B.

A major management priority is to maintain and improve the health and vigor of short-emergent native vegetation. The productivity and stability of this plant community is supported through the regeneration and growth of native graminoids. The use of flood and sub-irrigation can promote dense stands of native graminoids, but can also promote the growth of undesirable invasive plants such as Canada thistle and tall whitetop, especially in areas where the vigor of native plants has been compromised. Invasive weeds reduce the health of this plant community, so efforts would continue to control and eradicate weed populations. Proactive efforts would be taken to prevent extreme buildups of decadent vegetation through grazing, prescribed fire, and mowing and haying. When surveys of this habitat type show that live stem density is in significant decline, and when live-to-dead ratios of graminoids decrease beyond suitable conditions for wildlife, managers would begin corrective actions, and new growth of native plants would be encouraged by reducing or removing decadent vegetation.

Strategies for Short Emergent B1:

- Using historical soil and vegetation maps, use available refuge resources to focus water application efforts on areas where this habitat type occurred naturally. Actively divert water to flood the uppermost reaches of the creek drainages within the refuge. In the middle reaches of the creek drainages, leave water in the natural channels to provide sub-irrigation to adjacent vegetation. Since the lower reaches of the creek systems would receive little supplemental irrigation, portions of these areas would likely change to grassland.

- Use management treatments such as flooding, prescribed fire, prescribed grazing and haying, and herbicides to promote native plant communities and reduce and control invasive plant species.

- Map the distribution of weeds on the refuge. Continue to investigate weed control methods, including integrated pest management strategies, and monitor weed control efforts.

Short Emergent Objective B2. Use flood irrigation to inundate 50–70 percent of the potential irrigable acreage to a depth of ≤6 inches to promote conditions suitable for nesting shorebirds such as Wilson's phalarope. For example, if the surface water supply would allow for flood irrigation on 8,000 acres, then 4,000–5,600 acres would be shallowly flooded.

Rationale for Short Emergent B2. Short-emergent habitat can provide valuable nesting ground for shorebirds such as Wilson's phalarope. Previous studies have shown that Wilson's phalarope uses the short-emergent vegetation in and around wet meadows for nesting (Bent 1962, Colwell and Oring 1990, Stewart 1975). Prior studies on bird use of this habitat on the Baca Refuge have shown that more research was needed to document species presence and preferences with regards to nesting (Murphy 2009; Dieni 2010a, 2010b). In 2013, a small-scale study was started on the presence of nesting species in this irrigated habitat type. This research showed that the two most common nesting waterbird species in the short-emergent vegetation on the Baca Refuge were red-winged blackbird and Wilson's phalarope. Less common species included Wilson's snipe, mallard, teal, and American avocet. Various ground-nesting songbirds also reproduced in the upland edges and islands next to irrigated areas. Nationwide trends from the North American Breeding Bird Survey show that red-winged blackbird numbers have been in decline over the past 40+ years, while phalarope numbers appear to be more stable (Sauer et al. 1997). On a more local scale, numbers of both red-winged blackbirds and Wilson's phalaropes are in decline. From the limited research that has been conducted on nesting waterbirds on the Baca Refuge, it appears that continuing to provide short-emergent habitat will help these species. Nesting habitat characteristics vary widely for Wilson's phalarope (Dechant et al. 2003), but on the refuge, nests were most commonly found in irrigated meadows where live vegetation was <4 inches in height at the beginning of the growing season and little to no residual vegetation was present. Red-winged blackbird nests were also common in the irrigated meadows regardless of management treatments. Studies such as these are necessary to document the value of this habitat type for native, nesting birds, and to collect baseline data on the refuge's breeding bird species. Further research is necessary, especially with regard to habitat choice of birds under various management treatments.

Strategies for Short Emergent B2:

- In addition to managing hydrology, use a combination of treatments such as prescribed fire, grazing, and haying to provide a diversity of vegetative structure for foraging, roosting, and nesting birds.

- Rely on biological consultants, seasonal staff, interns, students, or volunteers to have sufficient resources to continue research efforts.

- Expand research to collect more information related to habitat use by native birds and quantify use of short emergent habitat, including spatial relationships of nests to topographical and water features, estimates of plant species richness and diversity, invertebrate abundance and diversity, and landscape-level influences such as weather and overall availability of habitat.

- Monitor and evaluate effects of management on wildlife species, particularly native birds and their habitats.

Short Emergent Objective B3. Maintain conditions on 10–20 percent (832–1,666 acres) of this habitat type to help upland ground-nesting passerines such as horned larks, Savannah sparrows, vesper sparrows, and western meadowlarks.

Rationale for Short Emergent B3. In 2011 and 2012, we conducted research to gain baseline knowledge on the importance of non-irrigated, dry meadow habitat for ground-nesting native passerines on the Baca Refuge. Species such as horned larks, Savannah sparrows, vesper sparrows, and western meadowlarks are common on the Baca Refuge, and they use dry meadows for nesting and raising their young. Research shows that population trends for horned larks, Savannah sparrows, vesper sparrows, and western meadowlarks have been in overall decline for the past 40+ years across the country. (Sauer et al. 2012). According to the same study, on a more local scale, horned lark and western meadowlark numbers are in decline, while local numbers of Savannah and vesper sparrows are stable or rising. Dry meadows on the refuge may provide important breeding habitat for these species, and using tools such as prescribed fire, grazing, and haying will provide a matrix of suitable habitat conditions for these species.

Strategies for Short Emergent B3:

- Direct flood irrigation away from selected areas so they will be intentionally left dry.

- Use a combination of treatments such as prescribed fire, grazing, and haying to reduce encroachment of woody vegetation and provide a diversity of vegetative structures for foraging, roosting, and nesting passerines.

- Monitor and evaluate effects of management on wildlife species and their habitat.

Short Emergent Objective B4. Develop and advance research on native wildlife (emphasizing migratory birds), their habitats, and the effects of management practices on a minimum of 5–10 percent (about 416–833 acres) of this habitat type.

Rationale for Short Emergent B4. Vegetation within the short-emergent habitat type is similar across the refuge complex in that certain plant species are common and have a wide distribution. Graminoids such as Baltic rush, common spikerush, woollyfruit sedge, field sedge, and various native grass species are dominant; forbs that commonly occur include silverweed cinquefoil, wild mint, bluntleaf yellowcress, wild iris, and false dandelion (FWS 2005, Dieni 2010b). Many factors also exist that cause heterogeneity within this plant community, affecting plant species composition, diversity, structure, regeneration, relative abundance, and distribution. This heterogeneity may be attributable to features and processes within this habitat type that include past management actions, differing topographical patterns, varying hydroperiods, soil conditions and type, occurrence of invasive plants, and vegetative conditions ranging from decadent to vigorous. We are interested in learning how these factors affect native wildlife species, and if there are ways to influence these factors to promote conditions that would improve wildlife productivity and reduce conditions that are not beneficial for wildlife. Previous research conducted at the refuge has been insufficient in addressing this variability and correlating it to habitat use by native wildlife, so future research efforts would emphasize these topics.

Strategies for Short Emergent B4:

- Work with the refuge inventory and monitoring program to acquire resources that would allow for collection of baseline information that relates to refuge management concerns, such as ground water levels, vegetation assemblages and condition, and wildlife species.

- Rely on professional biological consultants, seasonal staff, interns, students, and volunteers to have sufficient resources to continue research efforts.

- Monitor and evaluate effects of management on the plant community and wildlife species.

Objectives for Wetlands, Alternative C

Under alternative C, our goal for wetlands management would emphasize the restoration of ecological processes. By comparing the aerial maps from 1941 (figures 10, 11, and 12) with current vegetation classes (figures 43, 44, and 45), we identified the potential future conditions (figures 25, 26, and 27) under Alternative C that we would seek to achieve during the life of this document and beyond.

Alamosa and Monte Vista National Wildlife Refuges. Monte Vista Wetland Objective C1. From mid-February through March (spring migration), provide water to accomplish the following:

- Restrict water application to the historic Spring Creek and Rock Creek drainages (primarily the main channels) to provide foraging and pairing habitat for waterfowl as well as some roosting habitat for sandhill cranes. The tolerance level for invasive plant species is ≤10 percent.

Monte Vista Wetland Objective C2. From April through mid-June (nesting), provide water to accomplish the following:

- Restrict water application to natural waterflow paths and depressions associated with Spring Creek, Rock Creek, and Cat Creek to provide foraging and nesting habitat for waterfowl, shorebirds, rails, and other waterbirds. Tolerance level of invasive plant species is ≤10 percent.

Monte Vista Wetland Objective C3. From mid-June through August (brood rearing), provide water to accomplish the following:

- Flood to a depth of 1-3 feet about 250 acres annually, as a 5-year average, of open water and tall-emergent habitat to provide brood rearing areas for waterfowl and waterbirds throughout the refuge.

Monte Vista Wetland Objective C4. From September through October (fall migration), provide water to accomplish the following:

- Restrict water application to the Spring Creek and Rock Creek drainages to provide brood rearing areas for waterfowl and waterbirds throughout the refuge. Water application outside the main channels (in associated flowpaths and depressions) would be limited depending on snowpack levels. For example, in years with a large snowpack, water application would be extended to mimic natural runoff patterns.

Alamosa Wetland Objective C5. From mid-February through March (spring migration), provide water to accomplish the following:

- Restrict water application to irrigating vegetation in and adjacent to the deepest natural sloughs and oxbows formed by old channels of the Rio Grande to provide foraging and pairing habitat for waterfowl. Tolerance level of invasive plant species is ≤10 percent.

Alamosa Wetland Objective C6. From April through mid-June (nesting), provide water to accomplish the following:

- Restrict water application to irrigating vegetation in and adjacent to natural flowpaths, sloughs, and oxbows associated with the Rio Grande and its floodplain to provide foraging and nesting habitat for waterfowl, shorebirds, rails, and other wading birds. Tolerance level of invasive plant species is ≤10 percent.

Alamosa Wetland Objective C7. From mid-June through August (brood rearing), provide water to accomplish the following:

- Water application during this period would be primarily restricted to irrigating vegetation in and adjacent to the deeper portions of natural flowpaths, sloughs, and oxbows associated with former channels of the Rio Grande to provide brood-rearing areas for waterfowl and waterbirds throughout the refuge. Water application in the shallower portions of natural flow paths would be limited, depending on snowpack levels. For example, in years with a large snowpack, water application would be extended to mimic natural runoff patterns.

Alamosa Wetland Objective C8. From September through October (fall migration), provide water to accomplish the following:

- Restrict water application during this period to irrigating vegetation in and adjacent to the deepest natural sloughs and oxbows formed by old channels of the Rio Grande to provide foraging habitat for waterfowl.

Rationale for Wetland C1–C8. Under alternative C, we would restore ecological processes for all aspects of wetland management with the goal of returning native vegetative communities to their natural conditions (see Heitmeyer and Aloia 2013a,c). In particular, our water management would involve applying water only in locations where wetlands occurred, as determined by soil type, historic aerial photography, maps, and site descriptions. On the Monte Vista Refuge, those areas are primarily located along historic creek drainages such as Spring Creek, Rock Creek, and Cat Creek. Water application would strictly follow the natural hydroperiod. In essence, other than in the main channels themselves, water would be applied primarily to the natural flowpaths and depressions associated with these creek systems during periods when snowmelt runoff would naturally occur. Water management at the Alamosa Refuge would be similar. The timing of water application would follow natural snowmelt runoff patterns, and water would only be applied to natural wetland areas such as the flowpaths, sloughs, and oxbows associated with the floodplain of the Rio Grande.

Under natural conditions, water inputs would have been highly dynamic and would have varied seasonally and annually, with most water available during spring and early summer from snowmelt and runoff from the surrounding mountains. Most of the natural wetlands probably dried up by fall in most years, although deeper wetland depressions may have had retained some water during wet years or when ground water levels were high. As a result, native wildlife species are adapted to dynamic wetland habitats.

Compared with alternative B, we would expect to see a significant decrease in the amount of wetland habitat because all artificial wetland habitats would be restored to the native vegetation that was historically found on these sites. This would be accomplished through the removal or modification of much of the existing water management infrastructure such as levees, which were constructed to create wetland basins. Many of these basins were designed to spread water at varying depths across a broad area regardless of historic vegetative communities or soil types. Also, some basins located within portions of natural flow paths may be modified to change the depth of water, and the timing and duration of water application would be changed to mimic natural runoff patterns and other hydrologic changes, such as natural droughts. Overall, this alternative would not only result in a significant decrease in the amount of wetland habitat on the refuges, but would also change the type of many wetlands in some areas (see Heitmeyer and Aloia 2013a,c).

In addition to changes in hydrology, other management tools such as prescribed fire, prescribed grazing, and haying would be used to manage vegetative health and wetland productivity; however, the intensity, timing, and duration of these management activities would follow as closely as possible those disturbances that occurred naturally. For example, the use of prescribed fire would be used to enhance habitat quality, but under this alternative, a greater emphasis would be placed on natural fire frequency than in alternative B, where specific habitat objectives, such as removal of decadent vegetation, would be emphasized regardless of historic fire frequency. Similarly, rather than using prescribed grazing to achieve a specific vegetative structure required by some nesting bird species, the emphasis of grazing under this alternative would be to mimic natural grazing disturbance, which may not necessarily benefit some nesting birds.

Our policy and guidance documents highlight the importance of restoring historical processes, to assess opportunities and limitations for maintaining and restoring habitats in pre-Euro-American settlement conditions, and to encourage management that restores or mimics natural ecosystem processes or functions to achieve refuge purpose(s) (Meretsky et al. 2006, FWS 2001). Our policies also recognize that this is not always possible or desired.

Strategies for Wetlands C1–C8:

- Evaluate water infrastructure and manage water in a way that mimics natural hydrologic conditions.

- Fix or remove water management infrastructure as needed to facilitate the delivery and maintenance of waterflow in natural creek channels, flowpaths, depressions, sloughs, and oxbows.

- Fix obstructions such as roads, ditches, and levees that significantly alter surface and subsurface waterflows and that hinder restoration and management of natural wetland areas.

- Manage water to restore native upland and transition habitats based on ecological site characteristics.

- Manage the timing, duration, and volume of water in natural creek channels, flow paths, depressions, sloughs, and oxbows to mimic natural hydrologic regimes and subsequently restore and maintain wetland function, productivity, and sustainability.

- Use management treatments such as irrigation, prescribed fire, grazing, haying, and chemical herbicides to promote native plant communities and to reduce and control invasive weeds.

- Continue to provide wetland mitigation for the Closed Basin Project following the Fish and Wildlife Coordination Act Report and subsequent agreements (Coordination Act).

Evaluate use of mitigation water in other wetland areas to meet wildlife management objectives while complying with the Coordination Act.

Baca National Wildlife Refuge. Short Emergent Objective C1. Use flood and sub-irrigation on 10–20 percent of irrigable acreage by confining surface water to natural channels, oxbows, sloughs, and depressions. Shallowly inundate only the low areas that are beyond diversions.

Rationale for Short Emergent C1. Ditches, water control structures, diversions, and wells have significantly changed the hydrology and ecological integrity of the valley. Because of these changes, the valley's ecosystem is now largely artificial, and it no longer works as a natural system. It is probable that long-term factors such as reduced snowpack levels, changes in precipitation patterns, and larger landscape-level influences that affect aquifer levels also affect hydrological systems on the Baca Refuge. The refuge also has an expansive network of ditches, diversions, and water control structures that allow for flood irrigation over thousands of acres. This irrigation system allows managers to have flexibility in the management and application of water to different areas.

We would use this flexibility to keep most surface water in natural channels, which may help to contribute to a more natural hydrological system on the refuge. The hydrogeomorphic analysis completed for the Baca Refuge (Heitmeyer and Aloia 2013b) advocates that refuge managers restore sheet flow to natural floodplains. This may help restore the short-emergent habitat in areas where it naturally occurred. However, keeping surface water in the natural creek channels and only allowing for flooding in low areas would reduce the amount of artificially irrigated short-emergent habitat. The acreage that is no longer irrigated would then likely convert to the shrub–grass habitat type. Birds that nest in shrub–grass habitat include western meadowlark, Brewer's sparrow, vesper sparrow, loggerhead shrike, and sage thrasher.

Strategies for Short Emergent C1:

- Fix or remove water management infrastructure as needed to facilitate the delivery and maintenance of waterflow in natural creek channels, flowpaths, depressions, sloughs, and oxbows.

- Fix obstructions such as roads, ditches, and levees that significantly alter surface and subsurface waterflows and hinder restoration and management of natural wetland areas.

- Manage hydrology that mimics the historic locations of wetland habitat to restore native upland and transition habitats based on ecological site characteristics.

- Use management treatments such as water, prescribed fire, prescribed grazing, haying, and herbicides to promote native plant communities and reduce and control invasive plant species.

- Discontinue the use of water infrastructure located on high ground beyond points of diversion. Use current infrastructure for irrigation in low areas along natural channels.

Objectives for Wetlands, Alternative D

Our wetland management objectives under alternative D would be mostly similar to the approach used under alternative A with some differences. By comparing the aerial maps from 1941 (figures 10, 11, and 12) with current vegetation classes (figures 43, 44, and 45), we identified the potential future conditions (figures 25, 26, and 27) that we would achieve under Alternative D.

Alamosa and Monte Vista National Wildlife Refuges. Wetlands Objective D1. Similar to alternative A except we would focus more irrigation water in areas that are closer to public use areas.

Rationale for Wetlands D1. Similar to alternative A except we would focus available irrigation water in areas where public use occurs to create more wildlife viewing opportunities.

Baca National Wildlife Refuge. Short Emergent Objectives D1–4. Same as A except we would irrigate more areas closer to public use areas (refer to figures 22, 23, and 24).

Rationale for Short Emergent D–4. Same as A except irrigate more areas close to public use areas.

Objectives for Playa Wetlands

Playas are shallow, temporary bodies of water with clay substrates; their hydrological inputs are typically limited to precipitation and extremely localized surface runoff. Within the refuge complex, playa habitat is found primarily in the western portions of the Baca Refuge. Playas provide important foraging habitat for migrating and nesting shorebirds because of their macroinvertebrate populations.

Objectives for Playa Wetlands, Alternative A

Baca National Wildlife Refuge. Playa Objective A1. After wet meadows are sufficiently irrigated, allow excess water to enter the playa habitat to provide foraging and nesting habitat for waterbirds, particularly shorebirds and teal.

Rationale for Playa A1. Under this alternative, the wet meadow habitat on the Baca Refuge is the priority for water application during average or below average water years. Little to no water would be applied to the playa habitat until all the wet meadow acres associated with each watershed, including Crestone Creek, Willow Creek, Spanish Creek, Cottonwood Creek, and Deadman Creek, have been wetted for a sufficient period of time. After all the wet meadows have been sufficiently irrigated, any remaining water would either be allowed to continue to flow across the landscape into the playa habitat or would be diverted around short emergent habitats directly into playa habitat through ditch infrastructure using decreed points of diversion.

Under this alternative, water would not be applied to the playa habitat until later in the snowmelt runoff period, which would result in no available playa habitat for spring migrating waterbirds. Depending on the volume and duration of snowmelt runoff, water would not be applied, if at all, to playa habitat until in the middle or end of the breeding season, rendering the playa habitat largely unsuitable for many nesting waterbirds. However, there would be foraging habitat for a variety of shorebirds, wading birds, and waterfowl.

Strategies for Playa A1:

- Using decreed points of diversion, direct water to playa habitats after all the wet meadows associated with Crestone Creek, Willow Creek, and Deadman Creek have been wetted by allowing water to continue to flow across the landscape or by diverting water directly into the playa habitat through ditch infrastructure.

- Maintain the integrity of water diversion structures at decreed points of diversion.

- Evaluate the hydrologic and biologic response to water application in the playa habitat.

Collect information to assess the relationship between water application to the playa habitat and pumping from the Closed Basin Project.

Playa Objective A2. On years where above average water is available, divert a minimum of 20 percent of all available water to playa habitats using decreed points of diversion, In addition, playa habitats will be supplemented with any tail water available from the irrigation of short emergent habitats.

Rationale for Playa A2. During years when above average water is available in the creek systems entering the Baca Refuge, the refuge has the ability to use more of the decreed water rights. These additional water rights that come into priority are located in areas that allow this additional water to be used directly on playa wetlands. In addition, irrigation infrastructure associated with the short-emergent habitat areas cannot contain the volumes of water in the stream systems, and water must be diverted in playa diversions to protect against structure failure and to keep from excessive sediment buildup in the upper portions of the short-emergent habitats. This allows for the creation of suitable conditions for the widest range of species in both habitat types, and results in population explosions of species of importance such as tadpole shrimp, other invertebrates, and several species of amphibians which in turn attract species such as black-crowned night herons and nesting white-faced ibis that normally do not use refuge habitat.

Strategies for Playa A2:

- When above average water is available, refuge staff will divert a minimum of 20 percent of all water directly to playa habitats.

Objectives for Playa Wetlands, Alternative B (Draft Proposed Action)

Baca National Wildlife Refuge. Playa Objective B1. Adaptively rotate delivery of 20-30 percent of all available surface water directly to the playa habitats from four different input points a minimum of once every 3 years from one or more creeks annually to provide playa habitat during as much of the spring migration and summer nesting periods as possible for waterbirds and shorebirds (same as D1).

Rationale for Playa B1. Playa habitat has likely experienced the greatest amount of modification and degradation of all wetland habitat types, including riparian habitat, in the San Luis Valley. The only remaining functioning playa habitat in the San Luis Valley is on the Blanca Wetland Habitat Area and Russell Lakes State Wildlife Area, where hydrologic inputs come primarily from artesian wells.

Playa wetlands serve as important reservoirs of biodiversity (Haukos and Smith 1994). Although wildlife species such as waterfowl, passerines, and amphibians rely on playa habitat for breeding and foraging, shorebirds are perhaps the most dependent on these saline wetlands. Throughout North America, shorebird numbers have experienced declines (in some cases >70 percent) in the last 40 years (Howe et al. 1989; Page and Gill 1994; Brown et al. 2001; Fellows et al. 2001; International Wader Study Group 2003). The importance of playa habitat to shorebirds for migration and breeding has been well documented, especially in the Playa Lakes Region and Southern Great Plains (Reeves and Temple 1986; Davis and Smith 1998; Brown et al. 2001; Conway et al. 2005a,b; Andrei et al. 2006). Although the San Luis Valley does not receive as many migrant shorebirds as other areas such as the Great Basin and Playa Lakes Region, playas within the San Luis Valley still provide important migration habitat for many shorebird species. For example, the Blanca Wetland Habitat Area is a significant migration stopover for Baird's sandpiper, Wilson's phalarope, and American avocet. During migration, shorebirds select wetlands that offer sparse vegetation, mudflats, and shallow water where foraging conditions are favorable (Weber and Haig 1996, Davis and Smith 1998). In addition to providing needed resources for migrating shorebirds, playas are extremely important nesting areas for many shorebirds (Conway 2001, Conway et al. 2005a).

The current source of water for the playa habitats on the Baca Refuge is the creeks originating in the Sangre de Cristo Mountains, and water availability is dependent on the timing, duration, and volume of spring snowmelt. Consequently, water application to the playas may not coincide with spring shorebird migration. Peak shorebird migration in the San Luis Valley in the spring is typically during the first two weeks of May (S. Swift-Miller, pers. comm.). During the years when we would apply water to the playas, water would be delivered as early as possible using ditches and bypassing wet meadows in the attempt to create optimal conditions during as much of the spring migration as possible. This would also create conditions that are suitable for shorebirds and other waterbirds that breed in playa habitats in the San Luis Valley. During summer, conditions should be suitable for nesting Wilson's phalarope, which is a species of high concern under the U.S. Shorebird Conservation Plan; American avocet, which is a species of moderate concern under the plan; killdeer, which is a species of moderate concern under the plan; and black-necked stilt, which is a species of low concern under the plan.

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Great Plains toads are found on the refuge complex.

During years when water is successfully applied to playa habitats, refuge staff would maintain suitable hydrologic conditions for as long as possible and water would not be diverted to other locations or habitats before the creeks cease flowing during summer (during the irrigation season) as annually determined by the Colorado Division of Water Resources Division Engineer. In other playa areas when playas dried too early, there was a decrease in shorebird nesting success. Conway et al. (2005a,b) found that the loss of surface water by the middle of June resulted in abandonment of nests (particularly by American avocets) and the discontinuation of nesting by shorebirds in playas. As surface water disappeared, playa habitats changed as the amount of dry mudflat with vegetation increased, effectively reducing potential brood rearing grounds. The duration of surface water also influences invertebrate abundance, diversity, and community structure in wetlands (Neckles et al. 1990, Batzer and Resh 1992). Because invertebrates provide needed food for shorebird survival and reproduction, all attempts would be made to maintain the longest hydroperiod possible.

During years when water is delivered to the playas, some wet meadow habitats would remain dry because there would not be an adequate volume of water within the creek drainages for both the wet meadow habitat and the playa habitat during the same year. Therefore, following drought cycles in these habitats is essential for maintaining long-term productivity and overall wetland health.

Strategies for Playas B1:

- When available, divert water to specific playas for approximately 4 months.
- Work with BOR to better understand how irrigation of playa wetlands affects local ground water recharge and water supply for the Closed Basin Project.

Objectives for Playa Wetlands, Alternative C

Baca National Wildlife Refuge. Playa Objective C1. Direct, through decreed diversion points, at least 90 percent of the available water in each hydrological system (creek) into the lowest (elevation) flow path available (historic channels) to allow it to reach playa habitats in a manner that would provide some spring migration as well as summer nesting habitat for waterbirds, especially shorebirds and teal, while still maintaining suitable minimum flows in select off channel flowpaths where native fish occur within the Crestone Creek system.

Rationale for Playa C1. The biological benefits under this alternative would be similar to those under alternative B. Water would be allowed to enter the playas to provide waterbird foraging and resting habitat during as much of the spring migration as possible as well as to provide summer nesting habitat. The primary difference under this alternative is that water would annually be diverted from decreed points of diversion into the natural creek channels in all creeks as compared to only select creeks each year. This would result in more playa habitat being wetted annually, providing more food resources and more nesting areas for waterbirds, especially shorebirds and teal. Water would likely enter the playas sooner in the spring until it eventually reaches the playa habitat. Water would continue to enter the playa habitat throughout the duration of the snowmelt runoff period.

Strategies for Playa C1:

- Using decreed points of diversion, annually direct water into the creeks and allow water to flow into the playa habitat.
- Maintain the integrity of water diversion structures at decreed points of diversion.
- Allow water to enter the playa habitat throughout the entire snowmelt runoff period.
- Evaluate the hydrologic and biologic response of water application to the playa habitat.
- Collect data to assess the relationship between water application to the playa habitat and pumping from the Closed Basin Project.

USFWS\Koerner

The Brewer's sparrow is a rare grassland focal bird that would benefit from the conversion of the shrubgrass (transition grass) to more of the sandsheet rabbitbrush habitat type described under alternative C.

Objectives for Playa Wetlands, Alternative D

Baca National Wildlife Refuge. Playa Objective D1. Same as B1.

Rationale for Playa D1. Same as B.

Strategies for Playa D1. Same as B.

Uplands

Dominant upland species include rabbitbrush and greasewood. This native vegetation type occurs on all the refuges in the refuge complex as well as on an estimated 30 percent of the San Luis Valley.

Objectives for Upland, Alternative A

Alamosa and Monte Vista National Wildlife Refuges. Upland Objective A1. Continue to provide about 3,337 acres on the Monte Vista Refuge and about 2,696 acres on the Alamosa Refuge of native greasewood and rabbitbrush shrub communities for the benefit of nesting, migrating, and wintering migratory birds and other wildlife species (similar to alternative D).

Upland Objective A2. Continue to provide native shortgrass communities on the Alamosa Refuge (about 491 acres) and Monte Vista Refuge (about 330 acres), for the benefit of nesting, migrating, and wintering birds and other wildlife species (similar to alternative D).

Rationale for Upland A1–A2. Although upland shrub vegetation is relatively common, it is important for refuge managers to protect and maintain it on the refuge complex because it is a historic habitat type and contributes to the biodiversity of native species (similar to alternative D).

Strategies for Upland A1–A2. (Similar to alternative D):

- Research the use of these communities by wildlife and the amount and condition (relative to species composition of understory) of habitat needed on the refuge complex.
- Keep uninfested areas free of noxious weeds. In infested areas, reduce infestation by 40 percent over the life of this plan.
- Investigate the use of this habitat type by migratory birds through literature searches, analysis of existing data, and, if necessary, monitoring programs.
- Investigate the historic condition of shrubland communities in the San Luis Valley for potential restoration activities on the refuge complex.
- Use management treatments such as water, prescribed fire, prescribed grazing, haying, and herbicides to promote native plant communities and reduce and control invasive plant species.

Baca National Wildlife Refuge (2005 CMP). Upland Objective A3. Continue to manage shrublands on the Baca Refuge, taking corrective action when obvious degradation is occurring from invasive species.

Rationale for Upland A3. We would continue to manage the uplands, including the shrublands, using livestock grazing, prescribed fire, mowing, haying, or herbicides as we continue to learn more about the uplands on the Baca Refuge.

Strategies for Upland A3:

- Use a variety of tools to manage upland shrub communities including prescribed fire, herbicides, grazing, mowing, and haying.

Objectives for Upland, Alternative B (Draft Proposed Action)

For all the refuges in the complex, under alternative B, we would provide and manage shrub and grassland habitat, mimicking to the greatest extent possible natural hydrologic and disturbance regimes, to promote sustainable native ecological communities and provide habitat for songbirds and other wildlife species.

Alamosa and Monte Vista National Wildlife Refuges. Upland Objective B1. Enhance and maintain habitat diversity for migrating and breeding songbirds such as Brewer's sparrow, sage thrasher, and loggerhead shrike, and treat from 35 percent to 50 percent of the total estimated 3,667 acres of upland shrub habitat on the Monte Vista Refuge by incorporating disturbances such as prescribed fire and grazing.

Upland Objective B2. Within 1–2 years, begin restoration on a minimum of 50 acres of artificial wetlands on the Monte Vista Refuge by phasing out irrigation of these areas. By year 10-15 of the CCP, achieve 20–30 percent shrub cover and less than 10–15 percent invasive weeds in these areas.

Upland Objective B3. Within 2–3 years, begin restoration on a minimum of 100 acres of retired farmland on the Monte Vista Refuge. By year 10-15 of the CCP, achieve 20–30 percent shrub cover and less than 10–15 percent invasive weeds in these areas.

Upland Objective B4. Enhance and maintain habitat diversity for migrating and breeding songbirds and treat from 35 percent to 50 percent of the estimated 2,696 acres of upland shrub habitat on the Alamosa Refuge by incorporating disturbances such as prescribed fire and grazing into these habitats.

Upland Objective B5. Within 1–2 years, begin restoration on a minimum of 100 acres of artificial wetlands on the Alamosa Refuge by phasing out irrigation of these areas. By year 10-15 of the CCP, achieve 20–30 percent shrub cover and less than 10–15 percent invasive weeds in these areas.

Upland Objective B6. Within 2–3 years, begin restoration on a minimum of 100 acres of areas of retired farmland on the Alamosa Refuge. By year 10-15 of the CCP, achieve 20–30 percent shrub cover and less than 10–15 percent invasive weed cover in these areas.

Rationale for Upland B1–B6. Although the Alamosa and Monte Vista Refuges are known for their wetland resources, these wetlands are part of a mosaic that includes upland (predominantly shrublands). While many of these upland areas have remained relatively undisturbed, some areas have been greatly altered by past management. In attempts to expand wetlands (primarily short-emergent wetlands), many areas of native shrubland habitat were inundated which created hydric conditions on soil types that did not naturally support wetland plant growth. While wetland vegetation can persist in some of these created wetland areas if sufficient amounts of water are available, other areas have not become established because the volume, timing, and duration of water is insufficient and abiotic factors such as soils are not conducive to the formation of wetlands.

These artificially maintained wetlands rely on more water than is currently available and tend to be susceptible to nonnative invasions when only intermittently wetted. Thus wetland habitat quality is low to marginal and invasive weeds, particularly tall whitetop, readily become established. There is not sufficient water available to maintain quality wetland vegetation, and these areas are largely infested with invasive weed species. Therefore, we would return these areas to native shrubland communities. Within 10-15 years, we would restore a minimum of 50 acres of native upland on the Monte Vista Refuge and a minimum of 100 acres on the Alamosa Refuge by adjusting irrigation practices, incorporating disturbances such as fire and grazing, and selectively applying herbicides and other integrated pest management techniques to these areas.

Some created wetlands would be maintained where there is sufficient control over the volume, timing, and duration of water to maintain productivity and wetland function over the long term. Many of these areas provide specific resources to meet life cycle requirements of wetland-dependent animals. For example, although much of management unit 9 has been irrigated to convert native upland habitat to wetlands, in the past this area has consistently supported a greater density of nesting waterfowl than any other region in North America (Gilbert et al. 1996). Between 1964 and 1990, this area averaged 2,381 nests per square mile with minimal additional management needed. Portions of management units 19 and 20 have also been converted from native shrubland to wetland habitat. Because these areas are some of the most important and heavily used roosting areas for migrating sandhill cranes, they would be maintained.

Portions of native upland habitat on the Monte Vista and Alamosa Refuges were converted to farmland for the purpose of growing crops such as small grains and alfalfa. Much of this farmland has been retired, and the current vegetation in these areas consists primarily of annual and perennial invasive weeds such as tall whitetop and Russian knapweed. By employing various management strategies, we would restore native upland communities on a minimum of 100 acres of retired farmland on the Monte Vista Refuge and 50 acres on the Alamosa Refuge.

Restoration of upland habitats would be a top priority. This includes many created wetland areas as well as former farmland areas. We would reduce the number and extent of invasive weeds and promote the establishment, spread, and health of native shrubs and herbaceous species. In addition to the areas identified for restoration, there are thousands of acres of existing native upland habitat on the refuges which would be maintained and enhanced. However, management of the existing upland communities on the refuges, as compared to other habitat types, may be more limited because the structure and composition of these uplands are greatly affected by abiotic factors that we have no control over. For example, soil type, soil chemistry, and precipitation largely determine the species and density of this community.

Native upland communities tend to be dynamic and most likely require periodic disturbance, such as fire and grazing, to remain healthy and productive. Wildlife species using upland habitats are adapted to changes in short- and long-term environmental conditions. Managing for diverse vegetation types in the upland community would result in greater biodiversity of animal species, including insects, in this habitat. Our strategies, including prescribed fire, grazing, and hydrologic conditions, would mimic, to the greatest extent possible, natural disturbance regimes. By using these management actions periodically, we would provide a diversity of age classes and structure of shrubs as well as maintain or promote understory herbaceous vegetation to make sure that songbird nesting, brood rearing, foraging, and migration needs are met. Many of the songbird species found in the upland habitats on the refuges have experienced population declines throughout their range (Robbins et al. 1986, Askins 1993, Sauer et al. 1997).

Baca National Wildlife Refuge. Baca Refuge has several subclasses of upland habitat on the refuge (see figure 45, chapter 4) including greasewood shrubland, sandsheet rabbitbrush, and the unique shrub–grass component (transition habitat), which consists of large homogenous stands of rubber rabbitbrush with a grass understory and which is influenced by the adjacent wet meadows.

Upland Objective B7. To enhance habitat diversity for migrating and breeding songbirds, treat from 35 percent to 50 percent of the estimated 51,790 acres of greasewood shrubland and sandsheet rabbitbrush on the Baca Refuge by incorporating disturbances such as fire and grazing into these habitats. Maintain the diversity of the upland component by mimicking the natural disturbance regimes to create a variety of structural habitat conditions for breeding songbirds such as loggerhead shrikes, sage thrashers, Brewer's sparrows, vesper sparrows, and western meadowlarks.

Rationale for Upland B7. In addition to enhancing the greasewood shrubland and sandsheet rabbitbrush components through the use of a variety of management tools, we would select areas in the shrub–grass habitat and create disturbances of different types, sizes, frequencies, and intensities to create a matrix of different ages and densities. The promotion of diversity within this habitat is expected to have positive effects on its overall productivity, stability, and sustainability.

The shrub–grass habitat type shares characteristics with the sandsheet rabbitbrush, short emergent, and grassland habitat types. Rabbitbrush shrubs are the dominant mid-sized plant, and these are generally taller and have denser crowns than those found in the upland type. These shrubs respond well to disturbance and readily establish on disturbed areas on lands affected by fire or grazing. Their presence does not exclude other herbaceous species, and seed germination and viability is generally high. Rabbitbrush can reach maturity in 2–4 years, and its lifespan is usually between 5–20 years (McArthur and Taylor 2004). Herbaceous vegetation occupies the understory in shrub-grass areas, and includes a variety of species such as alkali sacaton, inland saltgrass, and Baltic rush. Shrub–grass areas receive sub-irrigation from adjacent flood-irrigated short-emergent habitats, and promoting more heterogeneity within shrub-grass areas would likely provide habitat for both shrub- and grassland-nesting birds. Poole (1992) found that loggerhead shrike nesting territories contained patchy mosaics of tall shrubs and grass or sand openings. In shrubsteppe and desert grassland, western meadowlarks prefer low shrub density and cover, patchy vegetative structure, varying heights of shrubs and forbs, and high coverage levels of grass, forbs, and litter (Lanyon 1962, Rotenberry and Wiens 1980, Wiens and Rotenberry 1981, Wiens et al. 1987, McAdoo et al. 1989, and Knick and Rotenberry 1995). In Nevada and Oregon, Wiens and Rotenberry (1981) found that vesper sparrows preferred areas with a diversity of plant structural types.

Strategies for Upland B1–B7 (All Refuges):

- Monitor for small mammals as an indicator of upland health.
- If needed, limit visitor use to reduce the spread of invasive species.
- Manage hydrology in a way that mimics, to the greatest extent possible, natural hydrologic conditions that would have existed on each site.
- Plant or seed native shrub and grass species on retired farmland areas.
- Use a combination of treatments, such as rest, prescribed fire, herbicides, grazing, and mowing to reduce and control invasive weed species.
- Study songbird use of native shrub and grassland communities.
- On the Alamosa and Monte Vista Refuges, limit water on upland areas by diverting it to flow paths.
- On the Alamosa and Monte Vista Refuges, remove the roads that promote impoundment of water. Remove obsolete water control structures and levees in former uplands.
- On the Baca Refuge, control invasion of rabbitbrush into shrub–grass communities as necessary.
- On the Baca Refuge, use a wide range of disturbance types, intensities, and frequencies to maintain or improve upland habitats based on existing community conditions. These disturbances may include prescribed fire, grazing, chemicals, and mowing. Study the short- and long-term effects of these disturbances and how they influence wildlife and overall habitat health.
- On the Baca Refuge, continue to irrigate adjacent meadows to promote subirrigation of shrub-grass areas, which is likely a major influence on density and coverage levels of herbaceous vegetation in this habitat type.
- On the Baca Refuge, determine how strategic, short-term changes in meadow irrigation affect adjacent shrub-grass areas.
- On the Baca Refuge, monitor the effects of habitat management actions on Gunnison prairie dog populations and adjust irrigation practices, reduce invasive species, or enhance habitat as necessary.
- On the Baca Refuge, map distribution of slender spiderflower and determine the primary factors that contribute to its presence within this habitat type.

Objectives for Upland, Alternative C

Alamosa and Monte Vista National Wildlife Refuges . Upland Objective C1. Same as B1.

Upland Objective C2. Within 4–5 years, begin restoration on a minimum of 1,000 acres of the Monte Vista Refuge that were formerly converted to wetland. By year 15 of the CCP, achieve 20–30 percent shrub cover and less than 10–15 percent invasive weeds in these areas.

Upland Objective C3. Within 2–3 years, begin restoration on a minimum of 450 acres of retired farmland on the Monte Vista Refuge. By year 15 of the CCP, achieve 20–30 percent shrub cover and less than 10–15 percent invasive weed cover in these areas.

Upland Objective C4. Same as B4.

Upland Objective C5. Within 4–5 years, begin native upland habitat restoration of a minimum of 800 acres of the Alamosa Refuge in areas that were formerly converted to wetland. By year 15 of the CCP, achieve 20–30 percent shrub cover and less than 10–15 percent invasive weed cover in these areas.

Upland Objective C6. Within 2–3 years, begin restoration on a minimum of 50 acres of areas of retired farmland on the Alamosa Refuge. By year 15 of the CCP, achieve 20–30 percent shrub cover and less than 10–15 percent invasive weed cover in these areas.

Rationale for Upland C1–C6. The hydrologic changes on the Monte Vista and Alamosa Refuges have resulted in extensive conversion of native upland habitats to wetlands. This conversion was accomplished through the construction of water management infrastructure without consideration of soil type and other abiotic factors. Subsequently, many areas of native shrubland habitat were inundated, creating hydric conditions on soil types that naturally do not support wetland plant growth. Under alternative C, because water will be applied only to natural wetland areas, such as creek channels, flowpaths, depressions, sloughs, and oxbows, many created wetland areas would be restored back to a native upland vegetative community. The result would be a significant increase in the amount of native upland habitat available for wildlife species such as Brewer's blackbird, loggerhead shrike, and sage thrasher, while the amount of wetland habitat on the refuges would experience a proportionate decline.

Portions of native upland habitat on the Monte Vista and Alamosa Refuges were converted to farmland for the purpose of growing small grains and alfalfa. Much of this farmland has been retired, and the current vegetation consists primarily of annual and perennial invasive weeds such as tall whitetop and Russian knapweed. Similar to alternative B, at least 100 acres on the Monte Vista Refuge and at least 50 acres on the Alamosa Refuge would be restored to native upland communities. Under this alternative, because farming would no longer take place, another 350 acres of farmland on the Monte Vista Refuge would be restored to native upland habitat.

Similar to alternative B, we would employ strategies that mimic natural disturbance regimes, such as prescribed fire and grazing, to promote long-term sustainability of the system as well as provide the vegetative structure and diversity that are vital to songbirds for nesting, brood rearing, foraging, and migration.

Strategies for Upland C1–C6. Alamosa and Monte Vista Refuges. Similar to alternative B except:

- Manage hydrology to mimic natural hydrologic conditions. For example, on the Alamosa and Monte Vista Refuges, restrict flooding of upland habitats to periodic, short duration events instead of the traditional prolonged flooding which has caused a conversion to wetland vegetation.

- Restrict large hydrologic inputs to natural creek channels, wetland flowpaths, depressions, sloughs, and oxbows.

- Plant or seed native shrub and grass species on retired farmland areas.

- Study the use of native upland communities by songbirds.

- Evaluate decrees for all water sources on the Alamosa and Monte Vista Refuges. Where needed, work with Colorado Division of Water Resources to change use, place of use, or points of diversion to accommodate new management objectives.

Baca Refuge. Upland Objective C7. Mimic historic disturbance regimes on upland habitats of the Baca Refuge by periodically using fire and grazing on 50–75 percent of the estimated 51,790 acres of upland shrub habitat to enhance habitat diversity for migrating and breeding songbirds and other resident wildlife. Convert 40–60 percent of the shrubgrass (transitional) habitat type (which would be 600–900 acres) to the sandsheet rabbitbrush habitat type through reducing nearby flood irrigation, which would diminish or eliminate subirrigation in this habitat type.

Rationale for Upland C7. Irrigation on the refuge would be reduced and natural processes would be restored or recreated to the extent possible. Surface water would not be diverted onto meadows through ditches and laterals. Instead, water would be restricted to natural channels. Wet meadow acreage would be significantly reduced, and the shrub-grass habitat type next to meadows would receive little to no subsurface water. Reducing the water supply would likely result in changes to shrubs and herbaceous vegetation. Rubber rabbitbrush shrub size would likely be reduced; shrub distribution would likely become sparser; crown density would lessen; the distribution, abundance, and species richness of herbaceous vegetation would shrink; and areas of bare soil would increase. Large amounts of shrub-grass acreage would likely convert to the sandsheet rabbitbrush habitat type, resulting in benefits to species such as Brewer's sparrows and sage thrashers. Studies from the Great Basin showed that Brewer's sparrow abundance is positively correlated with percent shrub cover, percent bare ground, and percent forb cover, and negatively correlated with percent litter cover and percent grass cover (Rotenberry and Wiens 1980; Wiens and Rotenberry 1981). Rotenberry and Wiens (1980) conducted research in a sagebrush plant community and found a positive correlation between sage thrashers and shrub height, horizontal patchiness, and bare ground, and a negative correlation with annual grass cover.

Strategies for Uplands Baca Refuge:

- Cease active flood irrigation practices on the refuge and allow surface water to remain in natural stream channels.

- Document correlations between changes in meadow irrigation and effects on adjacent shrub-grass areas.

- Study vegetation changes in areas that convert from shrub-grass to sandsheet rabbitbrush.

- Study the use of this habitat type by shrub- and grassland-nesting songbirds.

- Alter management strategies and objectives as habitats shift to sandsheet shrub type habitats.

- Map distribution of slender spiderflower and determine primary factors that contribute to its presence within this habitat type.

- Refine objectives as more information is gathered about this habitat type and its wildlife value.

- Evaluate decrees for all water sources on the Alamosa and Monte Vista Refuges. Where needed, work with Colorado Division of Water Resources to change use, place of use, or points of diversion to accommodate new management objectives.

Objectives for Upland, Alternative D

Alamosa and Monte Vista National Wildlife Refuges. Upland Objective D1. Similar to alternative A1.

Upland Objective D2. Similar to alternative A2.

Baca Refuge. Upland Objective D3. Similar to B7.

Wildfire

Objectives for Wildfire, Alternative A

All Refuges on the Complex. The 2003 CCP did not identify specific objectives for wildfire suppression. The current approach comes from Service policies and guidelines.

Wildfire Objective A1. Follow the following guidelines for wildland fire management:

- Suppress wildfires on the refuge complex using the most effective methods.

- Continue participation in the interagency fire management team to conduct wildfire suppression as well as prescribed fire.

Rationale for Wildfire A1. Although wildfires are infrequent on the refuge complex, they can result in significant loss of wildlife habitat and human property, both on and off the refuges. The USFS and the BLM maintain significantly more firefighting resources in the San Luis Valley than the Service does. Great potential exists to share and better use firefighting resources, not only among the Federal agencies, but also with State, county, and individual rural fire protection districts. In order to join in this partnership, we need to contribute resources proportional to those expended on refuge projects. Currently, wildfire mitigation projects associated with the refuge complex are often unfunded through the national fire plan and will remain so under the current fuels scoring system. This situation has demanded creative partnerships to accomplish needed reduction in wildfire threats on refuge lands.

Strategies for Wildfire A1:

- Continue involvement with the San Luis Valley interagency fire management team by contributing one half of full time equivalent (FTE), engine, and operating funding.
- Identify alternative funding to treat refuge lands to reduce hazards to adjoining property.

Objectives for Wildfire, Alternatives B–D

All Refuges on the Complex. Wildfire Objectives B1–D1. Follow all wildland-urban interface (WUI) guidelines and reduce potential damage to private property and loss of human life from wildfires on refuge lands.

Rationale for Wildfire B1–D1. For years, refuge staff and rural fire protection districts have been concerned about the high fuel load on the Alamosa and Monte Vista Refuges and the nearness of homes and other structures. This concern was heightened in 2003 with the creation of the Baca Refuge, which is adjacent to the Baca Grande Subdivision and downhill and upwind from the town of Crestone. The subdivision alone contains approximately 1,200 homes scattered through grassland and piñon and juniper woodlands. These concerns were identified and discussed in an assessment of the WUI issues for each refuge (Greystone Environmental Consultants 2004).

Strategies for Wildfire B1–D1. Same as alternative A plus:

- Minimize the construction of new facilities that would increase WUI obligations on the refuge.
- Maintain fire breaks on refuge lands where it is critical to human health and safety to contain wildfire or prescribed fire on refuge land.
- Explore other funding opportunities to conduct wildfire prevention projects in WUI areas.
- Evaluate WUI issues as part of wilderness review.
- Pursue hiring more staff to develop a burn monitoring program and detailed burn criteria in an effort to better understand the effects of prescribed fire and to better use fire in meeting management objectives.
- Work with the San Luis Valley Interagency Fire Management Unit, the State, counties, rural fire protection districts, municipalities, and landowners where needed to jointly address WUI concerns on refuge boundaries.
- Improve public education and interpretation about the need for WUI within the refuge complex.
- Hire a staff member dedicated to coordinating fire planning, implementing projects, and serving on an interagency resource team.
- Allow wildfires to be managed for multiple objectives as appropriate within the refuge complex and the fire management plan.

Wildfire Objectives B2–D2. Conduct research and a literature review to better understand fire's role in the environment of the refuge complex, especially in regard to land use development, climate change, and refuge mission and purposes.

Rationale for Wildfire B2–D2. We do not know a lot about the plant communities or the frequency and extent of wildfires before Euro-American development in the San Luis Valley, so we do not have a baseline for restoring ecological processes such as fire. The effect of wildfire on plant communities is not well understood, which limits our ability to manage fire for the benefit of the refuge complex.

Strategies for Wildfire B2–D2:

- Institute a monitoring program to assess ecological effects of all wildfires within the refuge complex.
- Use volunteers, students, contractors, or staff to conduct in-depth literature reviews of wildfire effects across various habitat types.

Wildfire Objectives B3–D3. Increase involvement with interagency partners including rural volunteer fire departments, and develop new memoranda of understanding.

Rationale for Wildfire B3–D3. Given the substantial investment that the USFS and BLM have made in wildfire suppression resources in the San Luis Valley and the geographic proximity of these other public lands to the refuge complex, it makes economic and operational sense that we integrate our wildfire suppression needs with these agencies. The Alamosa and Monte Vista Refuges have had a long history of relying on their respective rural fire protection districts for the initial attack on wildfires. Recent formation of the Baca Grande Fire Protection District offers opportunities for other partners to assist with initial attack on any wildfires on the Baca Refuge. In 2010, we entered into an agreement under the National Service First authority with the USFS, BLM, NPS, and the State of Colorado to share resources to support wildfire suppression and conduct prescribed fire operations. This agreement provides an excellent tool for us to achieve this objective, including integration with rural fire protection districts.

Strategies for Wildfire B3–D3:

- Continue active involvement with the San Luis Valley Interagency Fire Management Unit.

- Annually review memoranda of understanding with the Alamosa and Monte Vista Rural Fire Protection Districts and use agreements to increase involvement of volunteers in the Incident Command System and their associated qualifications so these individuals and departments can be reliably used in wildfire response and prescribed fire programs.

Wildlife Management: Threatened and Endangered Species

One endangered species is found on the refuge complex, the southwestern willow flycatcher.

Objectives for Southwestern Willow Flycatcher, Alternatives A–D

Alamosa National Wildlife Refuge. Southwestern Willow Flycatcher Objectives A1, B1, C1, and D1. Contribute to the recovery goals as described in the southwestern willow flycatcher recovery plan of 2002.

Southwestern Willow Flycatcher Objectives B2, C2, and D2. By year 5, maintain and enhance a minimum of 50 acres of existing suitable habitat on the Alamosa Refuge, and by year 10-15, restore or establish a minimum of 25-50 acres of suitable habitat at locations off the main channel of the Rio Grande.

Rationale for Southwestern Willow Flycatcher A1–D1 and B2–D2. The southwestern willow flycatcher is a small neotropical migrant whose breeding habitat is restricted to relatively dense stands of trees and shrubs in riparian ecosystems in the arid


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The southwestern willow flycatcher is an endangered species found on Alamosa Refuge.

southwestern United States (FWS 2002). Concern about the southwestern willow flycatcher on a range-wide scale became a focus when Unitt (1987) described declines in flycatcher abundance and distribution throughout the Southwest. The southwestern willow flycatcher was listed as federally endangered in 1995 (FWS 1995). At that time, the distribution and abundance of nesting individuals, their natural history, and areas occupied by breeding southwestern willow flycatchers were not well known and only 359 breeding territories among 30 sites were known to exist (Sogge et al. 2003). Since that time, thousands of presence and absence surveys have been conducted throughout the historical range of the flycatcher. As a result of these efforts, in 2007 the population was estimated at approximately 1,300 territories distributed among approximately 280 breeding sites (Durst et al. 2008). Surveys conducted on the Alamosa Refuge in 1996 and 1997 documented 29 territories. In the early 2000s, the number of documented territories began to decline, coinciding with a decline in habitat quality (see below), and by 2004, there were only 5 territories in the same survey areas (refuge files). By 2010, the number of documented territories had declined to 3. In 2013, critical habitat was designated, encompassing 8,345 acres of the Alamosa Refuge (FWS 2013b), which included the entirety of the riparian corridor along the Rio Grande as well as off-channel areas.

The greatest factor in the decline of the southwestern willow flycatcher is the extensive loss, fragmentation, and modification of riparian breeding habitat (FWS 2002). Habitat losses and changes have occurred and continue to occur as a result of urban and agricultural development, livestock grazing, water diversion and impoundment, stream channelization, and human disturbance (Marshall and Stoleson 2000; FWS 2002).

Hydrological changes, especially those that are human induced and long term, such as altered river flows due to water diversion as well as lowering of ground water tables due to withdrawals, can negatively affect breeding flycatchers because of deleterious effects to riparian habitat quality and extent as well as a reduction in prey availability. On the Alamosa Refuge, riparian habitat suitable for southwestern willow flycatcher has been severely degraded, especially in the last 10 years. There appears to be a current lack of recruitment and survival of young willows and cottonwoods, and refuge staff as well as Keigley et al. (2009) surmise that hydrology, rather than browsing, is the current driving factor in the lack of willow and cottonwood recruitment, growth, and survival. It is anticipated the willow community will eventually adjust to the lowered water table by moving to lower elevations that are nearer the water table.

Prior to refuge establishment in 1963, the Alamosa Refuge was a working cattle ranch. Consequently, it is presumed that livestock grazing within the riparian corridor likely had a negative influence on willow and cottonwood regeneration, growth, and survival. Since the establishment of the Alamosa Refuge, livestock grazing within the riparian corridor has been minimal to non-existent in at least the last 20 years. Although elk numbers on the Alamosa Refuge have grown from occasional animals before 1998 to approximately 450 in the late 2000s, they do not appear to be a dominant influence, except in localized areas, on willow and cottonwood growth and survival (Keigley et al. 2009) along the Rio Grande.

In 2000, the New Ditch diversion dam on the main stem of the Rio Grande completely washed out because of high river flows. As a result, water was no longer artificially backed up immediately upstream of the dam and river levels, along with the corresponding water table, fell. Refuge staff noted almost immediate mortality in many willows within this reach, presumably as a result of water tables dropping below the root zone of these willows. Shortly after, the extremely low snow pack in 2002 resulted in the worst drought year on record and river flows in the Rio Grande were virtually non-existent throughout much of the Alamosa Refuge. In 2003, another extreme drought year, river levels continued to remain low. As a result, there was a significant level of mortality of riparian vegetation throughout all reaches of the Rio Grande on the Alamosa Refuge, presumably because water tables declined below the root zone. Although drought is a natural event, the effects are compounded by human-induced alterations in the hydrology of the Rio Grande because of upstream water diversions, bank stabilization projects, water storage, and ground water pumping. As a consequence, hydroperiods and flow volumes have been altered to such an extent that regeneration and survival of riparian vegetation on the Alamosa Refuge has been negatively affected, even during years of average or above average snow pack. Furthermore, river morphology, sediment transport, formation of point bars, lateral movement of the river bed, and other factors have also been affected by these hydrologic changes. These factors have dramatically reduced the areas suitable for seed deposition and germination, creating a further decline in the natural regeneration of riparian vegetation.

Because the alterations upstream in the Rio Grande as well as the hydrology of the Rio Grande are beyond our control, management strategies would primarily involve using existing water rights to irrigate (via water diversion from irrigation canals), in the most practicable manner and to the greatest extent possible, existing areas of suitable southwestern willow flycatcher habitat to maintain and enhance the quality and integrity of riparian vegetation on about 50 acres on the Alamosa Refuge.

Although habitat characteristics such as plant species composition, size and shape of habitat patches, canopy structure, vegetation height, and vegetation density vary across the range of the willow flycatcher, suitable habitat usually consists of dense vegetation in the patch interior, or an aggregate of dense patches (Sogge et al. 2010). These dense patches are often interspersed with small openings, open water, or shorter and sparser vegetation, creating a mosaic that is not uniformly dense. Southwestern willow flycatchers nest in patches as small as 0.25 acres and as large as 173 acres, with a median patch size of 4.5 acres (FWS 2002). Nest sites typically have dense foliage from the ground level up to approximately 13 feet above ground (Sogge et al. 1997, Sogge et al. 2010). Of particular importance is the presence of slow-moving or still surface water or saturated soil at or next to breeding sites (Sogge et al. 2010).

In addition to maintaining or enhancing existing willow flycatcher habitat along the main stem of the Rio Grande on the Alamosa Refuge, efforts would begin to restore or establish another 50 acres of suitable habitat on off-channel sites. Restoration efforts would consider the habitat qualities and configurations described above, as well as provide open water next to or interspersed within habitat patches. Areas selected for these efforts would consider water management capabilities, soil type, and other factors.

In consideration of the special management actions that may be needed to maintain the integrity of flycatcher habitat, (FWS 2013b), visitor use on the existing Rio Grande walking trail as well as any proposed new trails would be restricted to on-trail use to reduce disturbance to birds, especially during migration, nesting, and fledging periods. We would inform visitors using these trails about the effects of human disturbance on southwestern willow flycatchers and how they can reduce disturbance through certain actions or behaviors.

Strategies for Southwestern Willow Flycatcher A1–D1 and B2–D2:

- At least once every three years throughout the life of the CCP, evaluate levels of wild ungulate and other wildlife species browsing within willow and cottonwood habitats.
- If browse surveys show that browse levels are preventing plants from reaching full stature, employ techniques such as fencing or, in cooperation with CPW, develop an adaptive management plan which may include elk dispersal and harvest as well as the temporary control of beavers and porcupines.
- Establish a hydrologic monitoring plan and install ground water measurement devices to study ground water levels.
- Develop a vegetation monitoring plan to assess the influence of hydrologic conditions on willow and cottonwood growth and survival.
- Plant willows and cottonwoods in suitable locations.
- Manage hydrologic conditions within riparian habitats along the Rio Grande and off-channel locations to the greatest extent possible to promote the regeneration, growth, and survival of willows and cottonwoods.
- Carefully manage and monitor agricultural practices in or next to riparian habitats.
- Manage, control, and use fire to enhance or promote the regeneration and growth of vegetation.
- Improve the morphology of the Rio Grande to manage erosion and sediment transport and stop further channel incising.
- Monitor southwestern willow flycatcher populations to document changes in habitat use and possible correlations to changes in habitat quantity and quality as well as visitor use of existing and proposed trails.
- Restrict visitors to on-trail use along the Rio Grande walking trail and proposed trails within riparian habitats.
- As necessary, use signs, seasonal closures, trail and road rerouting, or other measures to limit and reduce potential disturbance in areas where there is active restoration of willow and cottonwood riparian habitat.
- Inform visitors using methods such as visitor contacts, signage, and information pamphlets about how they can reduce disturbance to southwestern willow flycatchers during migration, nesting, and fledging periods.
- Ensure compliance (Section 7 consultation) with the Endangered Species Act for any disturbance (mechanical or human) within areas designated as critical habitat.
- Monitor southwestern willow flycatcher nests to determine if rates of parasitism by brown-headed cowbirds are of concern and if cowbirds need to be controlled.

Sandhill Cranes

This applies only to the Monte Vista Refuge, where we have provided small grains for migrating sandhill cranes and waterfowl.

Objectives for Sandhill Cranes, Alternative A

Sandhill Crane A1. Continue to support sandhill cranes by producing adequate agricultural grains (currently up to 270 acres depending on rotation and water availability) for fall and spring migrating waterfowl and 15 percent of the fall and 85 percent of the spring sandhill crane population on the Monte Vista Refuge.

Monte Vista National Wildlife Refuge

Rationale for Sandhill Crane A1. Sandhill cranes have changed how and when they use the San Luis Valley due in part to the many alterations in the quantity and quality of wintering and migratory habitat. Cranes and other wildlife have adapted to the current condition of the landscape, which is dominated by agriculture and other human practices. It is believed that there were historically more shallow water wetlands throughout the San Luis Valley, which provided a matrix of potential feeding sites (Drewien and Bizeau, 1974). Under current conditions there may not be enough wetlands in the San Luis Valley to provide the amount of natural food required by the more than 20,000 cranes that visit the area as there was in the past. It is also thought that cranes historically migrated through the valley later in the spring when more wetlands had thawed and invertebrates were more abundant. Currently, sandhill cranes migrate in February when most wetlands are frozen and cannot support invertebrate populations, but plant foods from the fall may still be available. Almost the entire Rocky Mountain population of greater sandhill cranes and several thousand lesser and Canadian sandhill cranes are now dependent on agricultural foods during their spring and fall migration. In the spring, these birds must replenish fat reserves to complete the migration to the breeding grounds and begin breeding efforts. Changes in agricultural practices in the past 10 to 15 years may have reduced the amount of waste grain available to migrating birds on private lands in the spring. There is sufficient water on the refuge in early spring to grow enough natural foods to feed the current flock. Therefore, the refuge's agricultural fields provide essential food supplies in the spring, when they are limited elsewhere in the San Luis Valley.

Strategies for Sandhill Crane A1:

- Continue to assess the amount and distribution of food for sandhill cranes in the San Luis Valley and plan the refuge farming program in response. In addition, work with the agricultural community to monitor changes in farming practices that may influence food availability for sandhill cranes.
- Attempt to lessen sandhill crane dependence on the Monte Vista Refuge farm fields in the spring. About 85 percent of the population uses the refuge for feeding and roosting during spring staging. We assume that this concentration exposes the population to risk of catastrophic loss.
- Explore the feasibility of providing more native foods for sandhill cranes in the spring and fall.
- Use livestock grazing, prescribed fire, and no-till drill, and control invasive species with chemicals and herbicides as necessary.

Objectives for Sandhill Cranes, Alternative B (Draft Proposed Action)

Monte Vista National Wildlife Refuge. Sandhill Crane B1. Similar to A1. In support of the Pacific and central flyway population goals for the Rocky Mountain population of greater sandhill cranes, produce a minimum of 190 acres of small grains (primarily barley) for spring migrating sandhill cranes on the Monte Vista Refuge.

Sandhill Crane B2. In both spring and fall, provide adequate roost habitat by shallowly flooding traditional crane roost areas.

Rationale for Sandhill Crane B1–B2. For centuries, the San Luis Valley has been an important migratory staging area for the Rocky Mountain population of greater sandhill cranes. During spring migration, an estimated 18,000–20,000 greater sandhill cranes and approximately 5,000–6,000 lesser and Canadian sandhill cranes inhabit the San Luis Valley between late February and early April, with most using the Monte Vista Refuge for roosting, loafing, and foraging. During this period, sandhill cranes need to build up energy reserves to finish migration to their nesting grounds (Tacha et al. 1987) breed successfully. The loss of natural shallow water wetlands because of land use modifications and alterations to hydrology has reduced the amount of potential foraging areas throughout the San Luis Valley (R. Drewien personal communication [date unknown]). It is believed that sandhill cranes did not migrate through the San Luis Valley until later in the spring when natural wetlands would have been largely free of ice and more invertebrates and other natural food sources would have been available. With the advent of agricultural production of small grains in the San Luis Valley over the last century, sandhill cranes began arriving as early as mid-February to take advantage of the waste grain left in agricultural fields after harvest. Sandhill cranes may have altered the timing of migration to take advantage of this readily available food source and now arrive to the San Luis Valley in late winter when most wetland areas are still frozen and natural food sources are largely unavailable in sufficient amounts to provide the energy required to build fat reserves. As a result, they have become dependent on small grain production in the San Luis Valley.

Sandhill cranes forage for small grains in the existing farm fields on the Monte Vista Refuge and on private agricultural fields. In recent years, fall tillage and irrigation of privately owned small grain fields have become increasingly widespread in the San Luis Valley. Farmers use these practices to encourage the growth and then subsequent freezing of waste seeds to get a clean field for spring planting. Since the late 1990s, the amount of acres in small grain production in the San Luis Valley has been dramatically reduced by replacement with alfalfa, which is a more profitable crop. These changes in farming practices have resulted in a reduction in waste grain availability for sandhill cranes during spring and have prompted concern over whether current or future food resources are adequate to meet spring demands for migrating cranes (Subcommittees on Rocky Mountain Population Greater Sandhill Cranes 2007; personal communication with Dave Olson, FWS Division of Migratory Birds, April 24, 2014). Therefore, we would continue agricultural production of small grains (primarily barley) on a minimum of 190 acres on the Monte Vista Refuge to make sure that this essential food resource is available for cranes in the spring.

Strategies for Sandhill Crane B1–B2:

- Continue to assess the amount and distribution of food for sandhill cranes in the San Luis Valley and plan the refuge's farming program in response to monitoring. Work with the agricultural community to monitor changes in farming practices that may influence food availability for sandhill cranes.

- Explore the feasibility of providing more native foods for sandhill cranes in the spring and fall.

- Maintain existing ground water rights that allow for flexibility in water application during the spring and fall.

- Through ground water pumping, provide adequate roost habitat (i.e., shallowly flooded (less than 15 inches)) on a minimum of two of the three traditional roost areas.

Objectives for Sandhill Cranes, Alternative C

Sandhill Crane Objective C1. Within 5-10 years, end grain production on the Monte Vista Refuge.

Monte Vista National Wildlife Refuge

Rationale for Sandhill Crane C1. As described for the wetland and upland objectives, we would restore and sustain historic vegetative communities based on natural hydrology and ecological site characteristics. Subsequently, the areas we have traditionally managed as roosting habitat (primarily in units 14, 19, and 20) would be restored back to upland habitat. This would result in the reduction of suitable roost habitat for sandhill cranes. Water application on the refuge would follow natural patterns. With the exception of water in the historic Spring and Rock Creek drainages, little to no water would be available for cranes when they are migrating and spending time in the San Luis Valley.

The effects of eliminating small grain production on sandhill crane body condition, future breeding success, and ultimately population size are largely unknown. Cranes may simply redistribute and increase their reliance on natural foods on the refuge as well as food resources provided on private agricultural fields where there is waste grain left following traditional harvesting practices. It is also not clear whether eliminating grain production could affect the timing of crane arrival in the spring or their departure south in the fall. If food resources are more limited, it is possible that they could remain on their wintering grounds longer. Additionally, the length of time cranes spend in the San Luis Valley may decrease if food resources are more limited.

Water that is now being used for farming operations could be used to promote and maintain native plant communities. This could also increase our pumping costs. Under the current Cooperative Farming Agreements, all pumping costs associated with refuge farming operations are now being paid by the permittee.

Strategies for Sandhill Crane C1:

- Remove all center pivots and restore all agricultural fields to native uplands on the Monte Vista Refuge.

- Reduce production of small grain steadily but slowly, allowing adequate time for cranes to adjust to this diminishing food source.

Objectives for Sandhill Cranes, Alternative D

Monte Vista National Wildlife Refuge. Sandhill Crane Objective D1. Produce a minimum of 230 to 270 (increase of 40 acres) acres of small grains (primarily barley) to provide food and energy resources for spring migrating sandhill cranes on the Monte Vista Refuge.

Sandhill Crane Objective D2. Similar to B2.

Rationale for Sandhill Crane D1. Visitor use would be emphasized and another 40 acres of small grain production would be established on former farm fields next to existing public use areas to maximize crane viewing opportunities. In the past, when these fields were farmed for the production of small grains, the refuge incurred all or most costs associated with the preparation, planting, and irrigation of these fields, which were extensive. Due to financial and time constraints, farming these fields was abandoned. It was felt that the amount of labor and the significant costs associated with farming these fields were too great and contributed little to the conservation of sandhill cranes. However, the production of small grains on these fields provided quality crane viewing because the fields are next to existing public use areas. Under this alternative, the production of small grains in these fields would occur. The refuge would explore ways to work cooperatively with a permittee where the permittee would incur most associated costs. If that is not possible, the refuge will incur all associated costs, including labor.

Strategies for Sandhill Crane D1. Same as alternative B plus:

- Improve public education about why the refuge produces grain on the Monte Vista Refuge.
- Return farm fields along the east side of Highway 15 to small grain production.
- Work with a cooperative farmer (permittee) to prepare, plant, and irrigate the added farm fields.

Wildlife Management: Focal Bird Species

All Refuges in the Complex. Focal Bird Objective A1. No specific focal bird objectives under current management.

Focal Bird Objective B1, C1, and D1. Manage refuge habitats as described below using water management and other tools such as prescriptive grazing, haying, mowing, and prescribed fire to create diverse hydrologic and vegetative conditions necessary to provide habitat for focal birds listed in tables 3 (wetland habitat), 4 (upland habitats), and 5 (riparian habitats) below.

Rationale for Focal Bird B1, C1, and D1. At the outset of the CCP planning process, we decided to approach future management with an emphasis on maintaining or restoring the composition, structure, and function of natural and modified habitats with the goal of long-term sustainability. We developed a vision of desired future habitat conditions, considering ecological site characteristics and wildlife needs, and developed sound management strategies that would maintain or restore the ecological integrity, productivity, and biological diversity of refuge habitats that are sustainable over the long term (described under habitat objectives, chapter 3). Thus, habitat-based, rather than wildlife-species-based objectives, were developed and management strategies were identified that emphasize the restoration and maintenance of system-based processes, communities, and resources that ultimately will help support local and regional populations of native plant and animal species. Although we developed habitat-based (rather than species-based) objectives, it is still important to have an understanding of the life-cycle requirements of wildlife species and develop a list of focal species (see tables 3, 4, 5) that would be used to guide these habitat-based objectives.

Lambeck (1997) recommends monitoring and evaluating focal species whose life history requirements define the habitat attributes that must be present if a landscape is to meet the needs for all the species that occur there. The key characteristic of a focal species is that its status and trend provide insights into the integrity of the larger ecological system to which it belongs. The rationale for using focal species is to draw immediate attention to habitat features and conditions that are most in need of conservation or that are most important in a functioning ecosystem.

Our focal bird objectives are tied to achieving our habitat objectives. For example, because hydrologic conditions during the breeding season directly affect whether breeding sites are suitable for wetland focal birds, refuge water management decisions would consider the species' needs for timing, depth, and duration of water application. Because vegetative structural conditions affect the suitability of nesting areas for focal species, along with water management, actions such as prescribed fire and prescribed grazing, mowing, or haying would be used to create the required vegetative conditions and mimic natural disturbance regimes that help maintain the productivity and overall health of wetland habitats.

Strategies for Focal Bird B1:

- Manage water using natural flow paths and created wetlands in a way that mimics, to the greatest extent possible, natural hydrologic regimes to restore and maintain wetland function, productivity, and sustainability. Use information available on life cycle requirements of focal species to guide management decisions.
- Monitor vegetation to assess if each focal bird's habitat needs are being met during each season of the year.
- Monitor focal species' population size, density, and habitat use to assess the effectiveness of habitat management strategies.

Table 3. Focal bird species for wetland habitats.

Assocaited bird species	*Habitat*	*Species of concern lists*
	Wilson's phalarope *(Phalaropus tricolor)*	
Wilson's snipe	**Habitat:** Sedge, grass, and rush meadows. **Microhabitat:** Moist to shallowly flooded (<6"). Prefers low vegetation height (6"–12"). **Nest site:** Nests on the ground in a shallow scrape lined with grasses near water. Food: Small aquatic invertebrates (dipterans and crustaceans, particularly brine flies and brine shrimp) in freshwater or hypersaline environments. They also feed on some terrestrial invertebrates and occasionally on seeds of aquatic plants.	U.S. Shorebird Conservation Plan, Intermountain West Joint Venture
	American avocet *(Recurvirostra americana)*	
Black-necked stilt, killdeer	**Habitat:** Prefers exposed, sparsely vegetated salt flats, sandbars, peninsulas, mudflats, or islands adjacent to shallow (<3' deep) water, conditions that occur in wetlands or lakes. **Microhabitat:** Moist to shallowly flooded (<6") for foraging. Prefers sparsely vegetated areas for foraging and nesting. **Nest site:** Nests near shallow water in small scrapes (lined with vegetation, small gravel, and feathers) on unvegetated ground (gravel or mud) or on elevated piles of debris with short, sparse vegetation that provides an unobstructed view from the nest. Often nest in loose colonies of 15–20 pairs with average distances of 100–260 feet between nests. **Food:** Variety of aquatic insects and their larvae (particularly Chironomidae and Ceratopogonidae), crustaceans, and seeds of aquatic plants.	U.S. Shorebird Conservation Plan, Intermountain West Joint Venture, San Luis Valley Waterbird Plan.
	Cinnamon teal *(Anas cyanoptera)*	
Blue-winged teal, northern shoveler, northern pintail	**Habitat:** Uses freshwater (including highly alkaline) seasonal and semipermanent wetlands of various sizes throughout the intermountain West, including large marsh systems, natural basins, reservoirs, sluggish streams, ditches, and stock ponds. **Microhabitat:** Prefers wetland basins with well-developed stands of emergent vegetation; uses emergent zones to a greater extent than open-water portions of basins. **Nest site:** Nests near water in low, dense perennial vegetation such as b=Baltic rush (Juncus balticus), saltgrass (Distichlis spicatum), spikerush (Eleocharis macrostachya), tufted hairgrass (Deschampsia caespitosa), western wheatgrass (Agropyron smithii), foxtail barley (Hordeum jubatum), and various forbs; less often at the base of greasewood (Sarcobatus vermiculatus), rabbitbrush (Chrysothamnus spp.). **Food:** Omnivorous diet consisting of seeds and aquatic vegetation, aquatic and semiterrestrial insects, snails, and zooplankton. Forages in shallowly flooded zones (<8 inches) along wetland margins; in deeper water, feeds at surface or in emergent or submergent vegetation. Feeds in emergent vegetation about twice as much as over open water. In the San Luis Valley, they prefer shallow, seasonally flooded open water and short emergent vegetation to other foraging habitats.	Intermountain West Joint Venture

Table 3. Focal bird species for wetland habitats.

Assocaited bird species	*Habitat*	*Species of concern lists*
	Mallard *(Anas platyrhynchos)*	
Gadwall, lesser scaup, short-eared owl, northern harrier	**Habitat:** Wide variety of habitats with dense cover, including grasslands, marshes, bogs, riverine floodplains, dikes, roadside ditches, and pastures. **Microhabitat:** Although commonly nests on uplands, in the San Luis Valley the preferred vegetation is tall dense (>15 inches) Baltic rush or other grasses with moist ground and interspersed with bodies of water. They commonly nest over water on the refuges. Early water application (2 weeks before peak spring migration) greatly enhances the probability of nesting. **Nest site:** Nests on ground in upland areas or meadows with moist ground near water or shallowly flooded wetlands. Nests are typically placed under overhanging cover or in dense vegetation for optimal concealment. Hen forms shallow depression or bowl on ground in moist earth and lines the bowl with vegetation and plant litter using what she can reach and pull toward her with bill while sitting on nest. Hen also pulls and bends tall vegetation over to conceal herself and nest. After incubation begins, plucks down from breast to line nest and cover eggs. Overwater nests range from simple bowls on floating vegetation mats to elaborate structures woven into emergent vegetation. **Food:** Omnivorous and opportunistic, generalist feeder. During breeding season, eats mostly animal foods, including insects such as midge larvae *(Chironomidae)* and other Diptera, dragonflies *(Odonata)*, and caddisfly *(Trichoptera)* larvae, aquatic invertebrates such as snails and freshwater shrimp, and terrestrial earthworms. Outside of breeding season, diet predominantly seeds from moist-soil plants, aquatic vegetation, and cereal crops (especially corn, rice, barley, and wheat).	Intermountain West Joint Venture
	Savannah sparrow *(Passerculus sandwichensis)*	
Western meadowlark, vesper sparrow, red-winged blackbird	**Habitat:** Uses grassy meadows, cultivated fields (especially alfalfa), lightly grazed pastures, roadsides, wet meadows, sedge bogs, and edge of salt marshes. **Microhabitat:** In the more arid parts of their range like the San Luis Valley, generally restricted to irrigated areas or to the grassy margins of ponds. Dense ground vegetation, especially grasses, and moist microhabitats favored. Generally avoid areas of extensive tree cover. **Nest site:** Nests are placed on the ground and well-hidden. Preferred sites include shallow depressions formed by nesting individuals in grass clumps or occurring naturally in the ground. Most nests are concealed by a canopy of dead grasses and herbs, or tucked under a tussock with a tunnel averaging 2 inches in length. Nests may be simple open cups, especially when hidden beneath shrubs, goldenrods, or other thick vegetation late in the season. **Food:** Primarily adult and larval insects, spiders, seeds and fruits, but occasionally insect eggs, millipedes, isopods, amphipods, decapods, mites, small mollusks.	San Luis Valley Waterbird Plan

Table 3. Focal bird species for wetland habitats.

Assocaited bird species	*Habitat*	*Species of concern lists*
American bittern *(Botaurus lentiginosus)*		
Common yellowthroat, sora, Virginia rail, yellow-headed blackbird, marsh wren, redhead, black tern	**Habitat:** Freshwater tall, dense emergent wetlands. **Microhabitat:** Dense emergent vegetation over water 2–8 inches in depth. Nests often over water in standing cattails, bulrushes and sedges; less often on dry ground. Nest becomes well hidden as surrounding vegetation grows. **Nest site:** Nest consists of a platform of reeds, sedges, cattail, or other available emergent vegetation, and is lined with fine grasses. Nests constructed by gathering surrounding dead vegetation into a platform and lining that with a layer of dry vegetation. **Food:** Insects, amphibians, small fish and mammals, crayfish. Forages along vegetation fringes and shorelines; seem to avoid even-aged stands of older, dense, or dry vegetation.	North American Waterbird Conservation Plan, Intermountain West Joint Venture, USFS Region 2 sensitive species, U.S. Fish and Wildlife Service Birds of Conservation Concern (BCR 16 and Region 6), Colorado State Wildlife Action Plan (Tier 1 species), San Luis Valley Waterbird Plan
White-faced ibis *(Plegadis chihi)*		
Snowy egret, black-crowned night-heron, common yellowthroat, sora, Virginia rail, yellow-headed blackbird, marsh wren, redhead, American coot, black tern, pied-billed grebe	**Habitat:** Freshwater tall, dense emergent wetlands. **Microhabitat:** Dense emergent vegetation over water 1–3 feet in depth. **Nest site:** Nests often over water primarily in standing bulrush but also cattails. Nests can be well hidden under dense canopy or out in open with no shielding vegetation. In latter situation, nest contents are fully exposed to direct sunlight but are blocked from cooling breezes. **Food:** Aquatic and moist-soil invertebrates, especially earthworms and larval insects (mainly Orthoptera, Odonata, Hemiptera, Coleoptera, and Diptera), but also leeches and snails. Forages in shallowly flooded wetlands, reservoirs, and marshes. Also feeds in recently flooded agricultural fields, especially young alfalfa, where vegetation is relatively short.	North American Waterbird Conservation Plan, Intermountain West Joint Venture, Bureau of Land Management sensitive species, San Luis Valley Waterbird Plan
Greater sandhill crane *(Grus canadensis tabida)*		
Mallard, northern pintail, cinnamon teal, blue-winged teal, green-winged teal, northern shoveler, gadwall	**Habitat:** Shallow water wetlands for roosting and foraging, agricultural fields planted to small grains for foraging. **Microhabitat:** Roosts and forages in shallow water wetlands/wet meadows with typically <6 inch water depths. Prefers roost sites with short (<1 feet) vegetation height. Forages in agricultural fields on waste grain or on refuge farm fields after mowing standing crop. **Nest site:** Spring and fall migrant through the San Luis Valley only. **Food:** Opportunistic foragers, which allows them to adapt to changes in food availability. Natural food items consist of roots, browsed vegetation, snails *(Helisoma* spp.*)*, crayfish *(Cambarus* spp.*)*, small mammals, frogs, snakes, toads, earthworms, and various insects. Cultivated small grains such as wheat or barley make up significant portions of diet during spring and fall migration.	Colorado State species of concern, Intermountain West Joint Venture, San Luis Valley Waterbird Plan

Table 4. Focal bird species for upland habitats.

Associated bird species	*Habitat*	*Species of concern lists*
	Brewer's sparrow *(Spizella breweri)*	
Loggerhead shrike, sage thrasher, western kingbird	**Habitat:** Shrubland habitat with big sagebrush, black greasewood, and occasionally rubber rabbitbrush. **Microhabitat:** Prefers nest shrubs that are mostly alive. Foliage of live shrubs provides concealment from predators and protection from elements. Although nests are typically placed in live shrubs with foliage, there is no preference for denser-than-average foliage. No preference for shrubs with discontinuous (gaps) versus continuous canopies. Compared with surrounding habitat, nests are usually located in taller, denser shrubs with reduced bare ground and herbaceous cover. **Nest site:** Nest is compact cup of dry grasses, weed stems, and rootlets; outermost material may consist of small sagebrush twigs. Cup lined with fine grasses, small strips of sagebrush bark, rootlets, and hair, often abundant horsehair. Typical shrub height of nest shrubs ranges from 16–40 inches with an average of 27 inches. **Food:** Small insects, mainly gleaned from foliage and bark of shrubs or dwarf trees; also seeds, usually taken from the ground. Forages mostly in shrubs; forages relatively little on open ground between shrubs or at base of bunchgrasses.	Partners in Flight Landbird Conservation Plan, Fish and Wildlife Service Birds of Conservation Concern (National and BCR 16), USFS Region 2 Sensitive Species, Intermountain West Joint Venture, Colorado State Wildlife Action Plan (Tier 1)
	Western meadowlark *(Sturnella neglecta)*	
Vesper sparrow, lark sparrow	**Habitat:** Primarily native grasslands and former agricultural fields converted to perennial grassland cover. **Microhabitat:** Preference shown for habitats with good grass and litter cover as well as forbs. Avoids nesting in areas where vegetation is tall and dense. Nest density is also negatively influenced by the amount of woody vegetation in the patch or landscape matrix surrounding breeding sites. **Nest site:** Well concealed, on ground, often in shallow depression and usually in fairly dense vegetation. Nest sites and nest patches typically have greater visual obstruction, vertical vegetation density and height, grass cover, and litter cover and depth. **Food:** Diet consists largely of vegetable (grain and weed seeds) and animal matter (insects). Favorite insect foods include beetles, weevils, wireworms, cutworms, grasshoppers, and crickets. Forages on the ground in open areas.	None

Table 5. Focal bird species for riparian habitats.

Associated bird species	*Habitat*	*Species of concern lists*
	Southwestern willow flycatcher *(Empidonax traillii extimus)*	
Yellow warbler, song sparrow, American robin, American goldfinch, western kingbird, common yellowthroat	**Habitat:** Riparian thickets, especially of willow, though other shrubs or trees may be used. **Microhabitat:** The breeding site must have a water table high enough to support riparian vegetation, and near (less than 60 feet) water or saturated soil in the form of large rivers, smaller streams, springs, or marshes. Requires dense vegetation, usually throughout all vegetation layers present. Characteristics of flycatcher nesting areas usually consist of dense vegetation in the patch interior, or an aggregate of dense patches. These dense patches are often interspersed with small openings, open water, or shorter/sparser vegetation, creating a mosaic that is not uniformly dense. Nest sites occur in patches as small as 0.25 acre and as large as 173 acres with a median patch size of about 4.5 acres. Nest sites typically have dense foliage from the ground level up to approximately 13 feet above ground. Of particular importance is the presence of slow-moving or still surface water and saturated soil at or adjacent to breeding sites. **Nest site:** Constructed in a fork or on a horizontal limb of willow or shrub. Nest is formed of forb stems, plant fibers, shreds of bark, and dry grasses. Nest cup is lined with feathers, hair, rootlets, and finer materials. **Food:** Somewhat of an insect generalist, taking a wide range of invertebrate prey including flying, and ground-, and vegetation-dwelling species of terrestrial and aquatic origins. Common food items include wasps, bees, flies, beetles, butterflies, moths, caterpillars, and spittle bugs.	Federally Endangered Species, Colorado State Endangered Species, U.S. Fish and Wildlife Service Birds of Conservation Concern (National, Region 6, and BCR 16), Intermountain West Joint Venture, Partners in Flight Landbird Conservation Plan, North American Wetland Conservation Act
	Western wood-pewee *(Contopus sordidulus)*	
Yellow warbler, American robin, western kingbird, common yellowthroat, Brewer's blackbird, Bullock's oriole, American kestrel, mourning dove, black-headed grosbeak, Swainson's hawk	**Habitat:** Riparian woodland and forest with large cottonwoods, especially along forest edge. **Microhabitat:** Large tree diameters (primarily narrowleaf cottonwoods), open understory, and dead trees or trees with dead limbs. **Nest site:** Nests placed in forks of horizontal branches, from near ground level or higher in height, in living and dead trees. Typically placed closer to the outer edge of the foliage than to the trunk in live trees. Compact, neatly woven of grasses, plant fibers, bark, plant down, feathers, and hair bound with spiders' webs; lined with fine grasses, hair; decorated with moss, insect puparia, exuvia, or bud scales. **Food:** Flying insects, especially flies, ants, bees, wasps, beetles, moths, and bugs. Primarily a sit-and-wait predator; flycatches (sallies) from open perches, usually returning to same or nearby perch; infrequently hover-gleans from vegetation.	Partners in Flight Landbird Conservation Plan

Wildlife Management: Bison

With the passage of the Great Sand Dunes National Park and Preserve Act of 2000 and the subsequent acquisition of BLM and Colorado State Land Board lands within the Medano Ranch, portions of TNC's Medano Ranch now lie within the Baca Refuge's authorized acquisition boundary. At the time of the acquisition, an arrangement or understanding was put into place allowing for continued grazing on refuge lands formerly controlled by TNC until a CCP could be developed. In this CCP and EIS, we are analyzing what role, if any, bison could have in the future on the Baca Refuge.

Objectives for Wildlife Management: Bison, Alternative A

Baca National Wildlife Refuge. Bison Objective A1. Within 1-3 years, phase out the existing arrangement that allows TNC to graze bison on the Baca Refuge lands that were formerly part of TNC's Medano Ranch (about 5,570 acres).

Rationale for Bison A1. Currently, TNC has been temporarily permitted to graze bison on those portions of the refuge that were acquired from BLM and Colorado State Land Board, where they formerly held grazing leases. This current arrangement would be phased within 1-3 years of the CCP completion. The approach with which TNC manages bison on its Medano Ranch property is inconsistent with both how the Service uses livestock to meet specific habitat goals and objectives identified in this CCP and EIS as well as to the stated purposes of the Baca Refuge (refer to chapter 2, section 2.1.6). Under alternative A, bison would not be used on the Baca Refuge.

Objectives for Wildlife Management: Bison, Alternative B

Baca National Wildlife Refuge. Bison Objective B1. Same as A1, C1, and D1.

Bison Objective B2. By year 1-5, pursue funding and resources necessary to develop and conduct a 5-10 year research project on the Baca Refuge to determine the feasibility of accommodating some semi-free ranging bison on a year round basis (contingent on research objectives) in a designated area (refer to figure 18). The research area would have habitat-type acreages that are roughly in proportion to the habitat types found on the greater landscape that includes NPS, TNC, and refuge lands (part of the greater Sand Dunes area). The objective of the research would be to determine if the refuge could support any number of bison to contribute to FWS bison conservation goals without compromising the refuge's purpose and the habitat goals for the areas where they would be grazed.


USFWS

There has been interest expressed in the reintroduction of American bison on Baca Refuge. The alternatives consider whether the Baca Refuge could support free-roaming bison without negatively affecting other species.

By semi-free ranging, we mean that although bison would still be subject to annual roundups and removal of animalsto maintain the herd size within the population level defined in the study design, the overall movements of bison on the landscape would not be managed or controlled.

Rationale for Bison B2. The 2008 Department of the Interior Bison Conservation Initiative (Initiative) outlines a framework for DOI bison conservation efforts, including principles and priorities for health and genetics management. We contribute to bison conservation through metapopulation management of our herds to conserve genetic diversity, minimize introgression and manage bison as wildlife to the extent practicable while meeting refuge purposes and goals. We recognize the intent of the Initiative and that some of our partners and stakeholders have long been interested in whether the larger landscape including the Baca Refuge, Great Sand Dunes National Park and Preserve, and TNC's Medano Ranch could support bison conservation as part of a larger metapopulation. The NPS is currently considering alternatives for bison management on park lands; a decision as to whether or how to manage bison on the park has not been made. Since bison are not singled out in the Baca Refuge's purpose, and much uncertainty exists regarding the potential impacts from bison on native wildlife species and their habitats, a temporary experimental herd would be introduced on refuge land first, which would provide information that would assist us in decisionmaking regarding the potential of future semi-free ranging bison on the Baca Refuge. Initially, we would introduce a year-round bison herd in a designated area and develop a specific monitoring program that would help us identify impacts to the plants, wildlife, and soils, in addition to gaining an understanding of the needed infrastructure that are unique to bison. This information would be valuable in determining any possibility of occurrence of a semi-free ranging bison herd on the Baca Refuge. We are especially interested in bison habitat selection and their potential impacts to breeding and migratory birds, plant community structure and function, and other native wildlife species. Within the research area, normal land management actions would not be excluded.

Strategies for Bison B2:

- Pursue funding and resources to conduct a research project on the Baca Refuge to determine the feasibility of long term bison presence on the landscape.

- Work with partners to create the bison and habitat research project on the Baca Refuge.

- Use computer modeling to determine the acceptable range of animals to use in the research area, with the major consideration being the desire to maintain suitable habitat conditions for other native species. Allow for (and maintain) an acceptable range of animals in the research area, based on what would be appropriate for overall habitat conditions. Continue to prescribe any necessary actions to maintain or enhance wildlife habitat within the research area, such as using fire, grazing, haying, mechanical and chemical treatments, etc. (as is done in other parts of the refuge).

- Design the research to answer in part some of the following questions:

  - the appropriate number of bison to introduce into the research area based on computer modeling results;

  - the specific patterns and trends of habitat/resource selection by bison;

  - the differences in bird nesting density and success between areas with and without bison;

  - the differences in avian species richness and abundance for breeding and migratory birds between areas with and without bison;

  - how the presence and movement of bison affect the presence and movement of elk herds;

  - how bison grazing affects plant structure, composition, and productivity (particularly in riparian and wetland plant communities);

  - overall differences in bison impacts between normal and drought years;

  - the effects on soils from bison grazing (particularly with regard to hoof impacts);

  - whether traditional habitat management tools continue to be effective (or enhanced) with the presence of bison on the landscape; and

  - whether the habitat can support bison as part of a larger metapopulation over the long term.

- If applicable, coordinate with the NPS and other partners to implement complementary bison management approaches in a manner that upholds the habitat goals and objectives for the Baca Refuge.

- Use adequate boundary fencing as necessary.

- Consider vehicle access, interpretive signage, and considerations for visitor safety.

- Allow the research period to extend to, but not beyond, the life of the CCP if such a timeframe is necessary to inform future decisions about the long-term occurrence of semi-free ranging bison on the Baca Refuge.

Objectives for Wildlife Management: Bison, Alternative C

Baca National Wildlife Refuge. Bison Objective C1. Same as A1, B1, and D1.

Bison Objective C2. Use bison prescriptively (not necessarily every year) to meet the habitat objectives on the Baca Refuge.

Rationale for Bison C2. Bison could potentially be used as a valuable management tool since neighboring herds could be conveniently located and may be readily available. Bison may be effective in creating specific habitat conditions desired by management, in contrast to results achieved by sheep or cattle. Archeological evidence and limited historical accounts show that bison are native to the San Luis Valley (Espinosa 1939, Spencer 1975, Meaney 1993). Their numbers and distribution, the timing of their presence, and their overall contribution to ecosystem patterns and processes are largely unknown. This lack of information prevents a full understanding of the ecological role of bison in the San Luis Valley. It is likely that bison may have played some role in shaping and maintaining various plant communities by providing a variety of effects such as soil disturbance from hoof impacts, stimulating regeneration of plants through grazing, fertilization with body waste, creating topographical depressions through wallowing, and so forth. These influences might be reproduced by the occasional, temporary prescribed use of bison in targeted areas on the Baca Refuge.

Strategies for Bison C2:

- Use bison to periodically to mimic ecological processes. Remove bison if habitat objectives are not being met.
- If applicable, coordinate with the NPS and other partners to implement complementary bison management approaches in a manner that upholds the habitat goals and objectives for the Baca Refuge.
- Use adequate boundary fencing as necessary. Consider vehicle access, interpretive signage, and considerations for visitor safety.

Objectives for Wildlife Management: Bison, Alternative D

Baca National Wildlife Refuge. Bison Objective D1. Same as A1, B1, and C1.

Bison Objective D2. Within 15 years, introduce a small (less than 25) demonstration bison herd in a designated area (similar to Sully's Hill National Wildlife Refuge) for public observation.

Rationale for Bison D2. Bison are a native, charismatic species that would attract more visitors to the Baca Refuge and better assist the Service with interpretation and education on overall bison conservation efforts by the Department of Interior and others. Under this alternative a small herd of bison (less than 25) would be introduced and maintained in a confined area near public access points on the refuge for the primary purpose of viewing and interpretation (see figure 24 and figure 27). Even though we would strive to maintain suitable habitat for other trust species (as part of the refuge's purpose) within the area where the bison are occurring, having bison on the refuge for educational and possible conservation purposes could outweigh overall habitat condition concerns. Thus, we would be willing to introduce bison without having habitat impact questions answered first, as proposed in alternative B. The bison area would be subdivided by cross fences and grazing impacts of the animals would be actively monitored and managed to ensure minimum negative impacts to rangeland health. These animals would be owned by us and subject to all health surveillance and genetic monitoring programs used by the Service, including annual roundups as required.

Strategies for Bison D2:

- Devote about 2,600 acres on the Baca Refuge for bison observation and interpretation (refer to figure 24 and figure 27).
- Use adequate boundary fencing to ensure that bison stay on the refuge and in designated areas.
- Construct round up and handling facilities if an arrangement to use privately owned facilities near the refuge cannot be made.
- Follow the Service's policy for disposal of excess animals.
- Consider vehicle access, interpretive signage, and considerations for visitor safety.

Wildlife Management: Rocky Mountain Elk

The Monte Vista Refuge is part of GMU 80, the Alamosa Refuge is part of GMU 83, and the Baca Refuge is part of GMU 82.

Objectives for Wildlife Management: Rocky Mountain Elk, Alternative A

All Refuges in the Complex. Elk Objective A1. Continue to conduct population surveys to monitor the density and distribution of the elk population on the refuges.

Elk Objective A2. Continue to cooperate with CPW in efforts to reduce and redistribute the elk population as necessary.

Rationale for Elk A1–A2. Resident elk herds are found on all three refuges, with about 200 elk remaining on the Alamosa Refuge year round and about 50 remaining on the Monte Vista Refuge year round. Currently, the refuge elk population on the Baca Refuge is estimated to average approximately 1,000 animals on a fairly consistent basis (Ron Garcia, personal communication). We have documented that elk frequently browse in the riparian areas, which are in a degraded condition from several factors. It has been found that recovery of riparian areas is not possible if the current browse levels continue (Keigley et al. 2009). Restoration of riparian plant communities is a major priority for refuge staff, mostly because of the high value of this habitat for neotropical migratory birds. Refuge elk herds will continue to be redistributed and culled in an effort to reduce the browse pressure on riparian areas in accordance with the interim elk management plan (FWS 2013e). In addition, by monitoring the population, we will continue to evaluate the effectiveness of these management actions.

Strategies for Elk A1–A2:

- Continue to conduct surveys of the refuge elk population on a monthly basis to monitor density and distribution of population.
- Monitor and evaluate the effects of management activities on the elk population and riparian plant communities.
- As monitoring dictates the need, we will remove elk from sensitive riparian areas of the refuge using various hazing techniques including lethal removal.
- Cooperate with the State in culling and harassment operations to reduce and redistribute the refuge elk population to meet the State's goals for numbers and sex ratios.

Objectives for Wildlife Management: Rocky Mountain Elk, Alternative B

All Refuges in the Complex. Elk Objective B1. Same as A1.

Elk Objective B2. Same as A2.

Rationale for Elk B1–B2. Same as A.

Strategies for Elk B1–B2. Same as A.

Elk Objective B3. On all the refuges, develop and implement a hunt plan (see "Hunting" in "Visitor services" section) that would assist managers to strategically reduce and redistribute the elk population to help meet CPW's goals for GMUs 80 (Monte Vista Refuge), 83 (Alamosa Refuge), and 82 (Baca Refuge); reduce the browsing pressure on riparian areas and other high use areas; and provide the public with high-quality big game hunting opportunities on the refuge complex.

Rationale for Elk B3. The need to reduce and redistribute elk is an issue on all the refuges, In particular, on the Baca Refuge, the elk herd in GMU 82 has grown significantly since the late 1980s, and is now estimated to be about 5,000 animals (Weinmeister 2010). The bull to cow sex ratio has also increased from an average of 26 bulls to 100 cows from 1988 to 2008 to about 39 bulls to 100 cows currently (Weinmeister 2010). The population and sex ratio have increased because a high percentage of the elk in the GMU occupy lands where hunting is prohibited, such as the refuge, Great Sand Dunes National Park (excluding the national preserve), and large private ranches. CPW is concerned about the impact of elk on vegetation and other ungulate populations such as deer, pronghorn, and bighorn sheep in GMU 82. In addition, the State is concerned about potential game damage to crops. The agency has been trying to maximize harvest by hunters to reduce the population (Weinmeister 2010). CPW recommends an elk herd of 3,000-4,000 with a sex ratio of 17 to 23 bulls per 100 cows for GMU 82 (Weinmeister 2010). We would cooperate with the State to reduce and redistribute the refuge's elk population to assist in meeting these goals. The implementation of a public hunt plan would provide hunter access to new areas (by special refuge permit) in GMU 82, and provide us, together with CPW and NPS, with an additional tool for the management of elk on the landscape. Additional hunting pressure in and around riparian areas would likely reduce elk browse on young willows and cottonwoods, improving chances for survival and recovery of riparian plant communities. A reduction in overall elk numbers and altered distribution patterns due to hunting pressure would also likely have similar positive results on riparian plant communities. It would also enable us to provide a high-quality elk hunting opportunity on the refuge (FWS 2006b and 2006e; refer to visitor services objectives below).

Strategies for Elk B3:

- Develop a public hunt plan for the refuge complex that helps managers to meet elk management goals.
- Monitor and evaluate the effects of public hunting on the elk population and riparian plant communities on the Alamosa and Baca Refuges.

- Take steps to ensure that the quality of elk hunting opportunities provided are kept at a high standard. This would be accomplished primarily by controlling the number of hunters allowed on the refuge during any given season.

- Coordinate and collaborate with NPS and other landowners to measure and determine how our management actions affect areas off the refuges.

- Work with NPS and CPW to address manage any hunting encroachment onto park lands (i.e., pushing elk back and forth across the boundaries).

- Coordinate closely with CPW and BLM in developing the trail access from the Monte Vista Refuge to BLM lands off of CR6 South.

- Coordinate on the use of all management tools including dispersal, hunter orientation and education, and law enforcement.

Elk Objective B4. Create a comprehensive monitoring plan for chronic wasting disease.

Rationale for Elk B4. Chronic wasting disease is a fatal neurological disease found in deer, elk, and moose. As of 2010, it has not been detected in wild populations in the San Luis Valley. Since this disease is a serious wildlife health issue with possible public health consequences and the potential exists for it to reach the refuge, managers should stay vigilant in monitoring for its presence. Appropriate actions would be taken if chronic wasting disease is detected in refuge complex elk, with specific details outlined in a chronic wasting disease monitoring plan.

Strategies for Elk B4:

- Work with CPW to monitor elk populations for the presence of chronic wasting disease.

Objectives for Wildlife Management: Rocky Mountain Elk, Alternative C

Elk Objective C1 and C2. Same as A1 and A2.

Rationale for Elk C1. Same as A1 and A2.

Elk C3–C4. Similar to B3 and B4 except the emphasis would be placed on achieving our overall habitat management objectives. There would be less emphasis on trying to ensure a wide range of quality elk hunting opportunities.

Rationale for Elk C3. Although many of the actions would be similar to be alternative B, under alternative C, the emphasis would be on achieving habitat management objectives and not necessarily on providing a wide range of quality recreational hunting opportunities.

Strategies for Elk C3. Similar to Elk B3–B4.

Objectives for Wildlife Management: Rocky Mountain Elk, Alternative D

Elk D1–D4. Same as B1–B4.

Rationale for Elk D1–D4. Similar to B1–B4 only there would be a greater emphasis would be on maximizing hunting opportunities.

Strategies for Elk D1–D4. Similar to B1–B4 plus:

- Work with CPW to determine the appropriate level of hunting permits for elk to achieve habitat objectives related to herd populations and herd composition, while also focusing on providing high quality opportunities for hunters involved.

- Take into account biological integrity and landowner tolerance when setting permit levels for elk hunting.

- Assess habitat and better understand big game behavior on the Baca Refuge.

- Determine where to apply pressure and clearly establish hunting methods, such as archery, muzzle loading, shotgun, and guided dispersal hunts.

- Work with the CPW to establish special hunts for elk, such as hunts that are available to only young hunters.

Wildlife Management: Rio Grande Sucker

This fish species is found on the Baca Refuge.

Objectives for Wildlife Management: Rio Grande Sucker, Alternative A

Baca National Wildlife Refuge. Sucker A1. Continue to monitor and evaluate the condition of Rio Grande sucker habitat. Where obvious degradation is occurring to the habitat through factors such as a reduced perennial water supply, take corrective actions.

USFWS

The Rio Grande sucker and chub (pictured) are found along Crestone Creek on Baca Refuge. The Rio Grande sucker was recently proposed for listing on the endangered species list.

Rationale for Sucker A1. This is a State endangered species which has been proposed for listing under the Endangered Species Act (2013). We would work with CPW to maintain a perennial water supply for Rio Grande sucker.

Strategies for Sucker A1:

- Monitor and evaluate the effects of other refuge management activities on the riparian plant communities.
- Improve spawning and feeding habitat by installing cobble and gravel substrates.

Objectives for Wildlife Management: Rio Grande Sucker, Alternative B

Baca National Wildlife Refuge. Sucker B1. Same as A1.

Sucker B2. Within 5 years, initiate a study on riparian restoration, and over 15 years, monitor the effects of riparian restoration efforts on the sucker population (refer to riparian restoration objectives above).

Sucker B3. Work with CPW to set specific priorities, identify projects, and enhance and increase sucker habitat on the refuge.

Rationale for Sucker B1–B3. The Baca Refuge has one of only two aboriginal (native) Rio Grande sucker populations in the State; therefore this population is crucially important for genetic conservation of the species. Although much of Crestone Creek is considered degraded, this population has persisted. We want to understand more about the population trends, distribution, and habitat use of the sucker populations as we move forward in restoring riparian conditions on the refuge, specifically the establishment of woody vegetation such as willows and cottonwoods, as well as making in-stream modifications, such as inducing proper meandering, elevating the streambed, introducing cobble to provide substrate, and reducing siltation and erosion. These efforts should benefit the Rio Grande sucker population, but we would work closely with CPW before large-scale restoration takes place.

Strategies for Sucker B1–B3:

- Map fish habitat and important stream features such as spring upwellings and other features that provide refugia for suckers.
- Cooperate with CPW to sample and monitor the fish population on a regular schedule, including sampling at different times of year.
- Acquire and use resources from the Service's inventory and monitoring program area to research habitat use by suckers.

Objectives for Wildlife Management: Rio Grande Sucker, Alternative C

Sucker C1. Similar to B, except restoring natural flow paths on the Baca Refuge would prevent fish from being trapped in the artificially created wetlands.

Objectives for Wildlife Management: Rio Grande Sucker, Alternative D

Sucker D1. Similar to B except for information where suckers typically occur.

Rationale for Sucker D1–D4. Similar to B1.

Strategies for Sucker D1–D4: Similar to B1.

Water Resources

Management of water resources is crucially important for providing wildlife habitat and visitor services within the refuge complex.

Water Management

Water, including several associated issues such as future legal constraints, limited staff, financial constraints, invasive species, and climate change, is one of the biggest management challenges for the refuge complex.

Objectives for Water Resources, Alternative A

All Refuges in the Refuge Complex. These objectives are in addition to the specific habitat, wildlife, and visitor services objectives specified elsewhere.

Water Resources A1. Starting immediately and continuing over the next 15 years, maintain all water rights, thereby enabling optimal use of ground and surface water for maintenance of wildlife habitat on all refuge lands. (Same as B1, C1, and D1.)

Rationale for Water Resources A1. The value of water and the competition for this increasingly scarce resource, especially in the arid west, grows every year. This trend is exacerbated by a changing climate and increased human demands. It is crucial to the mission of the Alamosa, Baca, and Monte Vista Refuges that we establish and maintain an accurate, regular, and reliable water use program that documents actual consumptive use, identifies all physical water facility needs and deficiencies, stays abreast of all legal and administrative water use changes, and provides an effective liaison between refuge staff and the professional water community and water user groups in the San Luis Valley.

Strategies for Water Resources A1:

- Establish a database of information that tracks historic use of all non-exempt ground and surface water sources and documents observed ecosystem benefits.
- Identify funding sources to rehabilitate failing wells. This is especially important on the Monte Vista and Baca Refuges. Each of these refuges has a significant number of important but old wells where the casings and mechanical systems are nearing the end of their functional lives.
- Develop a consistent, accurate, and defensible water use monitoring program (see Water Resources B10).
- Establish a hydrology program on the refuge complex in collaboration with the Region 6 division of water resources, with staff dedicated to maintaining water use records, collecting of water use data, maintaining proficiency in Colorado water law, advising the project leader in administrative and legal water matters, and representing the Service in all venues pertaining to San Luis Valley water management as it affects refuge operations.

Water Resources A2. Continue to irrigate small grain crops using the most labor- and water-efficient methods.

Rationale for Water Resources A2. Center pivot irrigation is far more labor and water efficient than flood irrigation practices and is the most practical technique available for raising grain with the least amount of labor and financial investment.

Strategies for Water Resources A2:

- Continue to use center pivot irrigation systems on these fields.
- Continue to evaluate the efficiency of water use by periodic evaluation of each system by an agricultural engineer.

Objectives for Water Resources, Alternative B (Draft Proposed Action)

All Refuges in the Complex. Water Management B1. Same as A1, C1, and D1.

Water Resources B2. By year 3, establish a repeatable and quantitative water quality monitoring program on all refuges to identify contaminants, toxins, and other possible contributors to poor soil and water quality.

Rationale. The ecological integrity of a number of national wildlife refuges has suffered from use of contaminated water. Although we do not have current evidence of water quality problems on refuges in the San Luis Valley, a systematic water quality monitoring program should be established to ensure that problems from poor water quality do not become an issue.

Strategies:

- Request help from the Service's division of water resources and environmental contaminants program, USGS, and Colorado Department of Natural Resources in designing a monitoring program.
- Identify resources required, including added staff, to begin water quality monitoring.

Water Resources B3. By year 5–6, complete area and capacity surveys of the most important wetlands on all refuge lands to enable a better understanding of the water resources required to maintain productivity.

Rationale. During most years, we plan water movement and flooding for the refuge complex based on annual biological objectives and water supply. Practical decisions about which wetlands are feasible to flood in any given year are always based on the experience of refuge staff members. This works well as long as experienced staff members are available and nothing unconventional is under consideration for the year. Since alternative B is describing a substantially different approach to flooding wetlands on the Monte Vista and Alamosa Refuges, access to engineering data will save an enormous amount of trial and error and likely prevent damage to refuge water control facilities.

Strategies:

- Conduct ground surveys.
- Conduct area capacity surveys.

Water Resources B4. Continue to irrigate small grain crops using the most labor and water efficient methods. (Same as A2, and D4.)

Rationale. Alternative B calls for continued production of small grain for sandhill cranes on the Monte Vista Refuge. Center pivot irrigation is far more labor and water efficient than flood irrigation and is the most practical technique available for raising grain with the least amount of labor and financial investment.

Strategies:

- Continue to use center pivot irrigation systems on these fields.
- Continue to evaluate the efficiency of water use by periodic evaluation of each system by an agricultural engineer.

Water Resources B5. Within 1-5 years, use ground and surface water together to achieve biological requirements.

Rationale. In order to use ground water in a sustainable manner, it must be more heavily relied on during those periods of high runoff that result in greater amounts of aquifer recharge and used less during drier periods. Rules and regulations pertaining to ground water pumping will require all nonexempt wells (wells that are governed by the priority system for water allocation) to be augmented to prevent ongoing injury to senior surface water users. Use of wells by the Service must be managed in a fashion that maximizes efficiency of use and meets the requirements of the rules and regulations. Surface water must also be managed to maximize efficiency of use and to augment ground water wherever possible.

Water Resources B6. In order to comply with upcoming Colorado ground water regulations and to contribute to sustainable use of ground water, all depletions to streams caused by use of wells on the three national wildlife refuges will be replaced during the next 15 years or earlier as regulations dictate.

Rationale. Once new regulations are put in place, all ground water users in the San Luis Valley will be required to replace stream depletions that negatively affect senior surface water users so that the surface water is augmented or replaced in time and place. The effects to senior surface users will be predicted by use of sophisticated ground water modeling. Currently, Colorado is perfecting a modeling program that, once completed, will be used by ground water users to design successful augmentation plans. With this tool, ground water users will be able to identify the drainages that their water use is affecting and quantify the effect. Once these objectives are defined, ground water users, including the Service, will have to decide on the most effective and efficient strategies or combination of strategies to accomplish augmentation requirements.

Strategies B5-B6:

- Contract with ground water management sub-districts of the Rio Grande Water Conservation District. Although we cannot be a member of these self-taxing entities, the law allows us (and other government entities) to derive the augmentation benefits offered by the sub-districts through contractual arrangements.
- Prepare individual augmentation plans for individual wells or groups of wells on the refuges. This places the burden on us and DOI for all legal and engineering planning and the identification of replacement water sources for the drainages that are affected by our wells.
- Form partnerships with other agency water ground water users to collectively augment wells by taking advantage of each agency's unique water resources.

Water Resources B7. Restore irrigation facilities historically used to irrigate playa wetlands on the Baca Refuge. Apply water to these playas based on availability of water and biological objectives. (Refer to habitat objectives above.)

Rationale. Functioning playa wetlands are the most under-represented type of wetland in the San Luis Valley. (Refer to playa habitat above.) These wetlands also provide important migratory bird foraging and nesting habitat. The Baca Refuge contains 17,048 acres of playa habitat, mostly along the San Luis Creek drainage on the west side of the refuge. Most of the playa habitat is within the Closed Basin Project and adjoins the largest well field in the San Luis Valley. This agricultural area is experiencing dramatic depletion of the unconfined aquifer, as documented by the ongoing monitoring program conducted by Davis Engineering, Inc., for the Rio Grande Water Conservation District entitled, "Change in Unconfined Aquifer Storage, West Central San Luis Valley" (Rio Grande Water Conservation District 2014). This study relies on a system of unconfined aquifer well measurements and has monitored water table levels since 1976. Due to chronic lack of runoff from the Sangre de Cristo Range, there have been stream depletions in San Luis, La Garita, and Saguache Creeks. In addition to these hydrologic restrictions, authorizing legislation requires the Secretary to reduce effects to other water users by using decreed water rights on the refuge in approximately the same manner as they were used historically. Finally, a significant amount of irrigation infrastructure servicing the playa area was allowed to deteriorate during prior ownership.

Strategies:

- Maintain and restore irrigation facilities used to deliver water to formerly irrigated meadows containing playa habitat such as the January Meadow to most effectively deliver water during higher runoff events.

- Enter into partnerships with BOR, the Rio Grande Water Conservation District, and any other downstream water users to assess effects of various refuge irrigation strategies on water supply for the Closed Basin Project and any other potentially affected water user.

- Conduct hydrologic analyses of different water scenarios to determine whether water delivery to playas results in effects to other water users.

Water Resources B8. Within 5 years, evaluate the Monte Vista Refuge as a site for confined and unconfined aquifer recharge.

Rationale. The west side of the Monte Vista Refuge overlays a zone of ground water recharge for the confined aquifer. The rest of the refuge is overlaid by the unconfined aquifer. Both the Monte Vista and Empire Canals periodically have water decreed for recharge. Two recharge ponds were constructed in the early 2000s along the west border of the refuge to accept water from the Monte Vista Canal and allow it to infiltrate into the confined aquifer. Historically, the refuge has been used by the Empire Canal to recharge the unconfined aquifer. However, that practice was recently stopped. In all cases, management of refuge wetlands would benefit from restored ground water levels promoted by these recharge opportunities.

Strategies:

- During the first year of the plan, discuss with the Monte Vista Water Users (Monte Vista Canal) their interest in and ability to expand the use of the refuge as a recharge site for their recharge decree. This would benefit the confined aquifer.

- During the first year of the plan, discuss with the Commonwealth Irrigation Company (Empire Canal) their interest in and ability to return to the practice of using the refuge as a site for unconfined aquifer recharge.

- During the first 5 years of the plan, conduct geologic evaluation of additional recharge sites to predict the specific location and effectiveness of recharge.

- During the life of the plan, construct more recharge facilities in response to the results from these investigations.

Water Resources B9. Establish the legal and practical feasibility of using Closed Basin Project mitigation water in different proportions and locations than described in the BOR's Project Authorization Act of 1972.

Rationale. Operation of the Closed Basin Project requires that wetland habitat lost as a result of project construction and operation be mitigated. The mitigation plan covers a number of projects that acquired land and water and placed them under agency management for the benefit of wetland habitat and associated wildlife. The project is authorized to annually deliver water to the Alamosa Refuge and the BLM-administered Blanca Wetlands. As knowledge of the wetland dynamics in the San Luis Valley grows, having greater flexibility with this mitigation water becomes increasingly appealing and could result in more effective wetland habitat mitigation. For example, this water could be combined and cyclically applied to selected playa wetlands that receive no water, which would result in an improvement in the overall health and function of the entire playa system.

Strategies:

- During the first year of the plan, determine whether this concept is legally consistent with the Closed Basin Project's authorizing legislation and the associated Fish and Wildlife Coordination Act Report.
- If there are no substantial legal impediments, work with BLM, BOR, CPW, and the Rio Grande Water Conservation District to reach an agreement on the feasibility of this approach during the first year of the plan.
- With these partners, develop a modified plan for potential use of this mitigation water during the second year of this comprehensive plan.

Water Resources B10. Develop a water monitoring program that measures the quantity, timing, and location of surface and ground water sufficient to comply with Colorado law and the refuges' biological management objectives.

Rationale. Competition for water in the San Luis Valley is steadily increasing as supply appears to dwindle from climate change and increased human demand. As regulations tighten and scrutiny from other water users increases, it is essential that refuge use of water is well tracked and documented to defend current uses and maintain our ability to meet refuge objectives that require water.

Strategies:

- Deploy instrumentation on all surface water sources. Maintain meters on all wells pumped at >50 gpm.
- Within 3 years, establish adequate ground water monitoring methods to understand the relationship between irrigation practices on the Baca Refuge, including effects on the Closed Basin Project.
- Within 5 years, establish a ground water monitoring program along the Rio Grande floodplain on the Alamosa Refuge that can be used to explain the relationship between river flows, adjacent irrigation practices, ground water levels, and the health of riparian vegetation.
- Within 3 years, establish a program to monitor well water levels to show short-term seasonal trends and long-term trends associated with aquifer depletion and restoration.
- Within 3 years, find and acquire adequate resources to accomplish this increased monitoring effort.

Water Resources B11. Evaluate the need to supplement existing water supplies, especially on the Monte Vista and Alamosa Refuges.

Rationale. Although wetland and riparian systems should be managed within a naturally occurring range of hydrologic conditions, having more water rights would be useful to help mitigate hydrology that has been greatly altered by human uses such as upstream diversions and ground water depletions that have significantly affected natural water regimes. Also, added water rights may be used in augmentation plans. In some circumstances, purchase of more surface water rights may be more cost effective than other alternatives that provide replacement water.

Strategies:

- Investigate potential water rights that may become available for sale. This may or may not include purchasing associated land.
- Investigate which water rights owned by others are having the greatest detrimental effect on the refuges or could supply the greatest benefit to the refuges and target these for potential acquisition.

Objectives for Water Resources, Alternative C

All Refuges in the Complex. Water Management C1. Same as A1, B1, and D1.

Water Management C2. Same as B2 and D2.

Water Management C3. Same as B3 and D3.

Water Management C4. Not included in this alternative.

Water Management C5. Same as B5 and D5.

Water Management C6. Same as B6 and D6.

Water Management C7. Same as B7 and D7.

Water Management C8. Same as B8 and D8.

Water Management C9. Same as B9 and D9.
Water Management C10. Same as B10 and D10.

Rationale. Similar to alternative B except C4 would not apply. We would not use pivot irrigation on the Monte Vista Refuge.

Strategies. Similar to alternative B except:

- Manage water to restore ecological processes to the extent possible. Water management for restoration of ecological processes would be given priority over visitor services or for the management of particular species.

- Pursue partnerships that maximize the ability of the refuge complex to effectively restore habitat.

Objectives for Water Resources, Alternative D

Water Management D1–D11. Same as B.

Rationale. Same as B.

Strategies. Same as B plus:

- Pursue partnerships that maximize the ability of the refuge complex to effectively restore habitat.

- Prioritize water management with a consideration for improving visitor experiences such as wildlife viewing.

- Collaborate with schools, Friends group, or volunteers to help with collecting water quality and quantity data.

Visitor Services

Visitor services includes the six priority public uses: hunting, fishing, wildlife observation, photography, interpretation, and environmental education.

Objectives for Hunting

Hunting for migratory game birds, primarily waterfowl and some small game (cottontail rabbit, white-tailed jackrabbits, and pheasant), is a popular activity on the Monte Vista and Alamosa Refuges. It is a compatible wildlife-dependent recreational activity. The alternatives consider options for expanding the hunting program to include big game on all three refuges and small game hunting on the Baca Refuge. This would include opening the Baca Refuge for recreational public hunting. All other wildlife is precluded.

Objectives for Hunting, Alternative A

The existing hunting program would be maintained.

Monte Vista and Alamosa Refuges. Hunting A1. Continue to provide safe and sustainable waterfowl and small game opportunities within designated hunt boundaries.

Rationale for Hunting A1. Hunting has long been an important cultural and social use of the lands that make up the refuge complex. On Alamosa and Monte Vista Refuges, wewould continue to provide for quality and diverse hunting experiences (about 800–1,000 hunter visits annually depending on available water and habitat).

Strategies for Hunting A1:

- Conduct periodic hunter surveys. (Same as B, C, and D.)

- Implement a waterfowl hunter education program. (Same as B, C, and D.)

- Provide consistent law enforcement. (Same as B, C, and D.)

- Conduct an annual informal evaluation of hunting program. (Same as B, C, and D.)

- Continue to respond to inquiries and provide information about current refuge hunting opportunities. (Same as B, C, and D.)

- Continue yearly review of refuge hunting regulations to ensure clarity and to address any emerging issues or concerns and give to the public an opportunity to review and comment on any changes. (Same as B, C, and D.)

- Update the refuge hunting regulations brochure to inform the public of hunting opportunities, including accessible opportunities and refuge-specific regulations. (Same as B, C, and D.)

- Distribute the refuge brochure more widely. (Same as B, C, and D).

Objectives for Hunting, Alternative B (Draft Proposed Action)

The hunt program would be expanded under alternative B.

All Refuges in the Refuge Complex. Hunting B1. Within the refuge complex, expand the current hunting program (refer to A1) by providing for diverse and quality hunting opportunities for big and small game hunting, as defined in the Service's guidelines for wildlife-dependent recreation (FWS 2006b). By year 3, develop a refuge complex hunting plan that is 50 percent implementable by year 4. By year 7, implement 100 percent of the hunting plan (same as C1 and D1).

Hunting B2. Within 6 years, work with partners to create diverse, quality hunting opportunities across the refuge complex. Within 6–7 years, complete a survey on user preferences and include questions needed to evaluate harvest success and quality of the hunts within the complex. Within 8 years, expect 60–70 percent of hunters to report a reasonable harvest opportunity and satisfaction with the overall experience.

Hunting B3. Within 4 years, working with CPW and within the State's hunting-season framework, expand opportunities for young people to hunt with at least one new hunt that is available only to young hunters.

Hunting B4. Within 5 years, improve existing accessible hunting facilities such as blinds, parking, and other facilities, and evaluate the demand for more access for hunters with mobility impairments. If warranted, within 10 years, provide one more hunting access point for hunters with mobility impairments within the refuge complex.

Alamosa and Monte Vista Refuges. Hunting B5. Same as A1 (waterfowl and limited small game hunting).

Hunting B6. At the Alamosa and Monte Vista Refuges, limit big game hunting to a restricted public hunt and agency-only culling. (Same as C3 and D6.)

Baca Refuge. Hunting B7. As part of creating diverse hunting opportunities (see B2 above), open small game hunting on the southwest corner during State-regulated seasons by year 3, and allow for a permitted archery hunting area north of Crestone Creek beginning in late August. By year 7, open other portions of the refuge to big game hunting (primarily elk but could include deer or pronghorn if populations increase) and expand small game hunting to include the three northwest sections.

Rationale B1–B7. The Service's wildlife-dependent recreation policy (FWS 2006e) emphasizes providing quality hunting experiences as an important part of a hunting program (605 FW1, 605 FW2). Promoting safety, providing reasonable opportunities for success, and working collaboratively with State wildlife agencies are just a few of the key elements that should be considered in providing for quality experiences. For example, a quality experience could mean that participants could expect reasonable harvest opportunities, uncrowded conditions, fewer conflicts between hunters, relatively undisturbed wildlife, and limited interference from, or dependence on, mechanized aspects of the sport. Although informal conversations with hunters can provide feedback to refuge managers about the quality of the experience, it would be important to ultimately conduct a formal survey of hunters to evaluate the hunting program within the refuge complex.

We would expand hunting opportunities and provide for diverse experiences, which would include opening the Baca Refuge for recreational hunting and providing opportunities for big game hunting on all three refuges in the complex. Because there are more adjacent roads near the Monte Vista Refuge, many safety concerns exist, and unaccompanied rifle hunting for big game would not be allowed. By expanding opportunities across the refuge complex, we hope to engage more young people in wildlife-dependent recreation, build a conservation ethic, and engender long-term enthusiasm and support for hunting, wildlife conservation, and the mission of the Refuge System. Early season or preseason hunts are best suited for youth because these seasons provide the best harvest opportunities. These programs would spark interest in hunting and hopefully lead to the recruitment of more young refuge supporters. There is also a demand for hunting opportunities that are accessible to hunters with special needs, such as hunters with mobility impairments; the current facilities to serve these hunters are in need of improvement.

Increasing hunting opportunities on the refuge and promoting the refuge complex's hunting program would increase license sales for CPW and boost economic activity in the San Luis Valley. Although this alternative could add more hunters than are now using the refuges and that would be expected under alternative A, it is anticipated that the vast majority of hunters would report satisfaction with their overall experience.

Strategies for Hunting B1–B7. Same as A plus:

- On the Baca Refuge, adopt CPW hunting seasons and regulations for those species for which harvest is allowed on the refuges. On the Baca Refuge, open small game hunting on the Southwest corner during State-regulated seasons and allow for a permitted archery hunting area north of Crestone Creek beginning in late August. By year 7, open other portions of the Baca Refuge to big game hunting and expand small game hunting to include the three northwest sections.

- For all the refuges in the complex, work with CPW to determine what level of hunting permits for elk would achieve habitat objectives related to herd populations and herd composition. Biological integrity and landowner tolerance would be considered when setting permit levels for elk hunting or other big game.
- Assess habitat and better understand big game behavior on the Baca Refuge. Determine where to apply hunting pressure and clearly establish hunting methods such as archery, muzzle loading, shotgun, or guided dispersal hunts.
- At the Baca Refuge, require mandatory check-in for unaccompanied hunters and during any big game hunt.
- Hunters must retrieve all game by walk-in or horseback only; no motorized vehicles would be allowed off established access areas. Horseback and game carts could be used. Consider game retrieval access on established roads in limited areas.
- Use annual wildlife surveys, car count data, and trail-cams to monitor and evaluate hunting use.
- If it becomes necessary because of increased hunting pressure and overharvest of certain species, use a refuge permit system to control the number of hunters.
- Maintain the ability of the refuge complex to set refuge-specific bag limits, season lengths, or other regulations.
- Work with the CPW to establish and coordinate hunter days or events for hunters with special needs.
- Work cooperatively with CPW to conduct law enforcement patrols at the refuge to enforce compliance.
- Work with partners (such as Wheeling Sportsmen and Wilderness on Wheels) to improve the current accessible blind at the Alamosa Refuge.
- Identify whether accessible hunting sites are needed and, if there is a demand for accessible sites, where they could be developed.
- Increase outreach about the refuge's accessible and youth hunting opportunities by developing a one-page tear sheet that explains the accessible and youth hunting opportunities and facilities. Post information on the Web site.
- Issue certain licenses to youth or special-needs hunters only.
- Work with the CPW to establish a special, permitted, weekend hunt for elk, small game, and waterfowl that is available to only young hunters.
- Improve information via mapping, kiosks, brochures, and signage on all three refuges.

Objectives for Hunting, Alternative C

The current program would be expanded over alternative A, but would be more focused on achieving wildlife and habitat objectives. It would take longer to bring to fruition than alternative B.

All Refuges in the Refuge Complex. Hunting C1. By year 5, develop a refuge complex hunting plan that is 50 percent implementable by year 10. By year 15, the hunting plan would be 100 percent implemented and the refuge complex would offer opportunities for big and small game hunting on the Baca Refuge and small game and waterfowl hunting on the Alamosa and Monte Vista Refuges.

Alamosa and Monte Vista National Wildlife Refuges. Hunting C1. Same as B1.

Hunting C2. Same as A1 (waterfowl and limited small game only).

Hunting C3. Same as B6 (big game-restricted public dispersal hunts and agency-only culling).

Baca National Wildlife Refuge. Hunting C4. At the Baca Refuge, by year 5, open small game hunting on the southwest corner during State-regulated seasons and open permitted big game archery hunting area north of Crestone Creek beginning in late August. By year 10, open the refuge to big game hunting and expand small game hunting to the three northwest sections.

Rationale C1–C4. The actions would be similar to B, except hunting activities would be more focused on achieving habitat and wildlife population objectives, such as targeting female elk or changing distribution, and there would be less emphasis on providing a recreational opportunity; therefore, it would take longer to phase in the hunting program across all the sections.

Strategies C1–C4. Similar to B.

Objectives for Hunting, Alternative D

We would maximize opportunities for recreational hunting.

All Refuges in the Refuge Complex. Hunting D1. Same as B1.

Hunting D2. Within 3 years, work with partners to create diverse, quality hunting opportunities across the refuge complex. Within 4–5 years, complete a survey on user preferences, and include questions needed to evaluate harvest success and the quality of the hunts within the complex. Within 10 years, expect 70–80 percent of hunters to report a reasonable harvest opportunity and satisfaction with the overall experience.

Hunting D3. Within 4 years, working with CPW and within the State's hunting-season framework, expand opportunities for young people to hunt with at least two new hunts that are available to only young hunters.

Hunting D4. Within 4 years, improve existing accessible hunting facilities and evaluate the demand for more access for hunters with mobility impairments. If warranted, within 8 years, provide a minimum of two more accessible hunting facilities or access points for hunters with mobility impairments at the Monte Vista and Alamosa Refuges. For hunters with mobility impairments, allow all terrain vehicles for game retrieval only.

Alamosa and Monte Vista Refuges. Hunting D5. Same as A1, B5 (waterfowl and limited small game only).

Hunting D6. Same as B6 (big game-restricted public dispersal hunts and agency-only culling).

Baca Refuge. Hunting D7. Similar to B7 (by year 3 open small game hunting in the southwest corner and allow for permitted archery), plus: As small game hunting and big game hunting are opened on refuge, increase quality opportunities for both hunters with mobility impairments and youths.

Rationale D1-D7. The actions would be similar to B, but efforts would be made to encourage more hunting opportunities across the complex, with a focus of increasing the number of accessible facilities and mentored opportunities for youths. Although providing for quality opportunities would be important, a larger number of licensed hunters could be allowed in D than B.

Strategies D1–D7 (all refuges). Same as B plus:

- Add 1 FTE employee for law enforcement to existing collateral duty FTEs. (Refer to table 7, chapter 3 below.)
- Provide more accompanied hunting.
- Solicit help from CPW to organize more mentored hunts.
- Offer more specialized hunts.
- Restrict access by others at specific times to increase harvest opportunities for hunters with mobility impairments.
- Allow motorized vehicle access on specific closed refuge roads for hunters with mobility impairments.

Objectives for Fishing

There is a limited fishery for northern pike and carp within the refuge complex along the Rio Grande. On the Alamosa Refuge, some anglers fish from the Chicago ditch dam when water is low and fish are concentrated within a small area; however, considerable safety issues exist, and fishing is prohibited. We provide for the Kid's Fishing Day at one of the ponds on the Monte Vista Refuge. The Friends group provides support in managing this event.

Objectives for Fishing, Alternative A

Fishing A1. Maintain Kid's Fishing Day at the Monte Vista Refuge (same as B1, C1, D1).

Rationale A1. We host an annual Kid's Fishing Day at the Monte Vista Refuge during National Fishing Week. This event is geared toward teaching children how to fish.

Strategies A1:

- Work with CPW and local partners to organize and run Kid's Fishing Day at the Monte Vista Refuge.

Objectives for Fishing, Alternative B (Draft Proposed Action)

Fishing B1. Same as A1, C1, and D1.

Rationale B1. Same as A1, C1, and D1.

Strategies B1. Same as A1, C1, and D1.

Objectives for Fishing, Alternative C

Fishing C1. Same as A1, B1, and D1.

Rationale C1. Same as A1.

Strategies C1. Same as A1.

Objectives for Fishing, Alternative D

Fishing D1. Same as A1, B1, and C1.

Fishing D2. Within 5 years, permit walk-in fishing access along the Rio Grande at the Alamosa Refuge south of the parking area 5. Also develop a safe access point and pier to allow people to fish at the Chicago Dam on the Alamosa Refuge.

Fishing D3. Within 3 years, evaluate and establish another fishing opportunity or event at the Alamosa Refuge to encourage more local youth participation from the Alamosa community.

Fishing D4. Within 4 years, build an accessible trail and fishing dock on the Rio Grande at the Alamosa Refuge.

Rationale D1-D4. The Service would work with partners on ways to increase fishing opportunities, especially for youth. The opportunity to expand and develop a closer partnership with CPW and others to expand youth fishing opportunities would further the refuge complex's goal of introducing youth to the Refuge System.

Strategies D1-D4:

- Work with CPW and other local partners to sponsor a fishing event for young anglers.

- Seek partnerships or alternative funding for establishment of more fishing access points and fishing programming.

- Use protective measures as necessary to safeguard any southwestern willow flycatcher habitat.

Objectives for Wildlife Observation, Photography, and Interpretation

The abundant wildlife resources found on the refuge complex attract many visitors to the San Luis Valley. The largest draw is the Monte Vista Crane Festival, which attracts thousands of people annually during the spring migration of sandhill cranes. This event, which is put on in partnership with the refuges' Friends group and the local community, provides a significant boost to the local economy. Other visitors explore the auto tour routes at the Monte Vista and Alamosa Refuges, walk the nature trails (defined as trails with some type of interpretation, either signs or brochures), or enjoy the spectacular vistas from the Bluff Overlook at the Alamosa Refuge. Overall, access for visitors wanting to enjoy nonconsumptive recreation has been limited.

Objectives for Observation, Photography, and Interpretation, Alternative A

The objectives and strategies would be aimed at maintaining existing facilities.

Alamosa and Monte Vista National Wildlife Refuges. Observation, Photography, and Interpretation A1. Maintain existing wildlife observation and interpretive facilities and programs (about 15,000–20,000 nonconsumptive visitor use days, including special events) (figure 13 and 14).

Observation, Photography, and Interpretation A2. Maintain the existing auto tour routes and nature trails.

Rationale A1–A2. Under alternative A, provide and maintain the same level of visitor services for these activities. Facilities that support these activities include auto tour routes, nature trails, signs, parking areas, and kiosks. A survey conducted by the USGS found that visitors who come to the refuges for nonconsumptive activities found birding and wildlife observation to be the most important activities. The auto tour routes and interpretive trails help facilitate these activities (USGS 2011b).

Strategies A1–A2:

- Maintain or upgrade existing facilities, signs, Web site, brochures, exhibits, and other programs.

- Adhere to Service standards.

Baca National Wildlife Refuge. Observation, Photography, and Interpretation A3. Develop primitive wildlife observation and interpretive facilities along the boundary with the Baca Grande subdivision.

Observation, Photography, and Interpretation A4. Develop an accessible trail (compliant with the Americans with Disabilities Act) at the entrance to the Baca Refuge along Saguache County Road T.

Observation, Photography, and Interpretation A5. Develop limited interpretive facilities in and around the Baca Refuge office and visitor contact station.

Rationale A3–A5. Under alternative A, even though the Baca Refuge wouldn't be open for public use, there is still considerable interest in the refuge and some limited facilities would be needed.

Strategies A3–A5:

- Develop a kiosk with signage and information and provide limited interpretation in and around the Baca Refuge office.

Objectives for Observation, Photography, and Interpretation, Alternative B (Draft Proposed Action)

The objectives and strategies would be geared toward enhancing existing visitor services .

All Refuges in the Refuge Complex. Observation, Photography, and Interpretation B1. Within 5 years, develop and complete a visitor service plan for the refuge complex that identifies specific programming elements including interpretive themes, messages, and audiences for wildlife observation, photography, and interpretation.

Observation, Photography, and Interpretation B2. Within 4–6 years, hire an outdoor recreation planner for the refuge complex. (Refer to objectives for refuge operations.)

Alamosa and Monte Vista National Wildlife Refuges. Observation, Photography, and Interpretation B3. Increase participation and enhance opportunities for wildlife observation, photography, and interpretive activities on the Alamosa and Monte Vista Refuges by improving the quality (FWS 2006e) and number of programs and facilities that are offered for wildlife observation, photography, and self-guided and staff-dependent interpretation. By year 15, increase annual visits to the refuges by 15–25 percent (1,500 to 4,000 more visits per year), with most visitors (75+ percent) reporting satisfaction with their experience and the facilities that we offer.

Observation, Photography, and Interpretation B4. Same as A2 plus: Within 2–3 years, from July 15 to about February 28 (end of the waterfowl season), open more access opportunities on a seasonal basis (outside nesting periods) for walking or other compatible modalities such as bicycles and skis using existing trails or Service two-track roads within the refuge complex and areas that are now only available to hunters for walking or other compatible access. Work with partners to develop a trail system that ties the current city trails to the Alamosa and Monte Vista Refuges (figures 16 and 17).

Observation, Photography, and Interpretation B5. At the Alamosa Refuge, within 3–7 years, extend the auto tour route to the east to connect with Bluff Road. Improve the accessibility of the Rio Grande nature trail and enhance the quality of the experience by providing better visitor amenities such as seating, shelter at the end of the current trail, and improved interpretation such as updated brochures, interpretive panels, directional signs, and viewing platforms. Provide increased seasonal availability (about July 15 to February 28 or the end of the waterfowl season) by opening about 5.4 miles of existing trails and Service two-track roads for walking, biking, or cross-country skiing that are now only available to hunters during the hunt season. Expand the Bluff interpretive nature trail down to parking area 4 and link a new trail from the town of Alamosa to connect with the refuge (figure 17).

USFWS

Under alternatives B and D, the Meadowlark Nature Trail on Monte Vista Refuge would be improved and provide for more interpretation and accessibility.

Observation, Photography, and Interpretation B6. At the Monte Vista Refuge, within 4–5 years, improve visitor access, facilities, and information to include 1) accessibility modifications to Meadowlark Nature Trail with information about trail length (1 and 4 miles) and add a viewing blind; 2) replace small kiosks at parking areas 1, 2, and 3 with three-sided standard kiosks; 3) develop bird viewing area north and east of parking area 3, including an accessible parking area, trailhead, viewing blind, trail, and observation platform; develop one crane observation pull-off and parking off county road 6S and replace the signs at the crane pull-offs (figure 16). Seasonally open about 9 miles of trails within the hunt boundary for biking, walking, and cross-country skiing.

Observation, Photography, and Interpretation B7. By year 15, design and build a new visitor center and office at the Monte Vista Refuge and the refuge complex (figure 16). Link trails from the new visitor center with connections to the Meadowlark Nature Trail, the auto tour route, and other destinations. Repurpose or remove the existing buildings at the headquarters office at the Alamosa Refuge and construct volunteer recreational vehicle pads.

Observation, Photography, and Interpretation B8. Within 10 years, work with partners to develop a trail from the town of Monte Vista to connect to the Monte Vista Refuge. In coordination with BLM, develop a trailhead on county road 6S with a parking area large enough for horse trailers to provide nonmotorized access to BLM land.

Baca National Wildlife Refuge. Observation, Photography, and Interpretation B9. Within 1–2 years, open the Baca Refuge for compatible, wildlife-dependent public uses (about 1,000–3,000 visits initially), including access by nonmotorized modalities such as biking, walking, and limited horse access. By year 15, improve outreach and opportunities and increase visitation gradually to 10,000–15,000 visits per year.

Observation, Photography, and Interpretation B10. Within 5–10 years, develop an auto tour route, install wayside interpretive panels along the auto tour route, and develop a looped interpretive trail around the refuge's headquarters area (old Baca Ranch) with several interpretive panels or other interpretive media positioned along the trail route (figure 18).

Observation, Photography, and Interpretation B11. Work with agency partners, our Friends group, and others to adaptively re-use one of the cattle headquarters buildings to serve as a staffed orientation and interpretation center for natural and cultural resources throughout the San Luis Valley.

Observation, Photography, and Interpretation B12. Work with NPS to manage and interpret the Trujillo Homestead.

Rationale B1-B12. The refuges are centrally located to the communities of Alamosa, Monte Vista, and Crestone. Currently, outside of waterfowl hunting, opportunities to view wildlife on the Alamosa and Monte Vista Refuges are limited. Many members of our Friends group, along with other visitors, have expressed a desire to have more opportunities for wildlife observation, interpretation, and other nonconsumptive uses. Several respondents in the visitor survey conducted by the USGS for the Monte Vista Refuge also expressed these views (USGS 2011b). Funds to support a quality visitor services program have been nonexistent. Concerns about disturbance to wildlife as well as safety concerns about general visitation occurring at the same time as waterfowl hunting have also been a factor. Initially, Service resources would be spent on improving habitat conditions on the refuge complex, and improvements to visitor services would likely take 15 years to fully implement. Partnerships, volunteers, and Service outreach efforts would be essential for successful implementation. Any new or enhanced visitor opportunities would have to be compatible with the primary purposes of the refuges (refer to appendix D), and we would continue to limit access during critical breeding and nesting periods across the refuge.

Even with the current funding challenges and other concerns, it would be realistic to increase and enhance the opportunities available to see wildlife and enjoy nonconsumptive activities by a modest to moderate amount. Birding is growing faster than any other form of outdoor recreation. Providing facilities like viewing blinds that enhance viewing experiences represents an investment in the local economy and helps to create a conservation constituency (CDOW 2007). To increase visitor use days by 10–25 percent (approximately 1,000–4,000 more visits annually at the Monte Vista and Alamosa Refuges) or to open the Baca Refuge to public use and increase visitation to 10,000 visitor use days, the refuge complex would need to invest in better viewing facilities and programs (for example, building viewing blinds and platforms or by improving access and linkages) for visitors to enjoy and appreciate the role of the Service both within the San Luis Valley and across the Refuge System. We would also need to encourage visitation to the refuges through better outreach at the local level.

An essential part of achieving our objectives and strategies, particularly with the opening of the Baca Refuge for public uses, is to hire an outdoor recreation planner for the refuge complex. Much can be accomplished with even one FTE dedicated to this position. This person can help set the direction for visitor services, manage the program, work with volunteers, and seek funding opportunities such as grants or other partnerships. As the visitor services program is put in place, visitor surveys would be important for evaluating the success of our efforts at getting our messages out to the public.

In the short term, even within existing funding constraints, there are ways we can work in partnership with others to improve and develop facilities. Initially, we would begin by allowing access to the refuges outside of the critical breeding period from about July 15 to February 28. Visitors could take advantage of existing two-track roads to walk or bike. Simple markers could be used to post suggested routes. New and expanded wildlife observation and photography facilities could be designed to complement the natural settings within the refuge.

Strategies B1–B12 (all refuges):

- Inventory, maintain, and replace interpretive panels, signs, or kiosks, as needed.

- Maintain existing auto tour routes or refuge access points.

- Create brochures that interpret each of the complex's interpretive themes and highlight how they are relevant to each of the three refuges. Also consider publishing brochures that address complex and Valley-wide topics such as hydrology and landscape conservation.
- If demand arises or is identified, provide interpretive materials in Spanish.
- Identify observation areas through signage and maps.
- Develop separate brochures for each refuge in the complex.
- Develop more interpretive exhibits and materials.
- Develop Web site-based materials such as bird lists and information, maps, and Webcams.
- Routinely update the Web site and incorporate changing interpretive content into the design.
- Increase advertising of events, activities, and special programming.
- Recruit more volunteers.
- Coordinate partners and other specialists to conduct guided interpretive tours.
- When expanding auto tour routes, improve roads to be all-weather roads and inform visitors if travel would be difficult or require high-clearance vehicles.
- Work with the NPS to manage and interpret the Trujillo Ranch on the Baca Refuge.
- Continue to cosponsor special events related to wildlife and habitat conservation.
- Determine locations where the refuge road and trail system could tie into community trail systems. Determine whether existing trails should be re-routed in places to minimize impacts or improve linkages.
- Coordinate closely with CPW and BLM in developing the trail access on the Monte Vista Refuge to BLM lands off of CR6 South.
- Use protective measures such as seasonal closures, signage, education, or trail redesign as necessary to limit potential impact to southwestern willow flycatcher or other wildlife. Require visitors to stay on the Rio Grande Nature Trail and Bluff Nature Trail on the Alamosa Refuge.
- Staff the visitor contact station at Alamosa 2–3 days per week.
- At the Alamosa Refuge, replace the kiosk at the visitor station and worn interpretive panels at the visitor station and along the auto tour route.
- On the Baca Refuge, consider trails that connect with adjacent land where biking and equestrian use is allowed.
- On the Baca Refuge, open elk and small-game hunting areas to non-hunters (excluding archery-only areas). Limit access to seasonal use on elk units. Allow year-round access on small game units by non-hunters.
- Acquire and establish a system for using temporary and moveable observation facilities at the playas and other viewing areas, particularly on the Baca Refuge where wildlife viewing opportunities are directly related to precipitation or movement of wildlife.
- Allow virtual geocaching on open areas of the refuges to enhance the environmental education experience.
- In developing an auto tour route at the Baca Refuge, use the footprints of existing roads where practical. Follow design guidelines that reduce visual and resource effects and intrusions on the landscape.
- Allow for seasonal walking and biking opportunities on the Alamosa and Monte Vista Refuges and improve linkages if necessary.
- Allow for some year-round walking, biking, and horse access on the Baca Refuge.
- Evaluate visitor programs and the Service's visitor services standards.

- Apply for grants to stabilize the significant buildings and structures at the two Baca Ranch complexes.

Objectives for Observation, Photography, and Interpretation, Alternative C

The objectives and strategies would be aimed at maintaining or adapting public uses.

All Refuges in the Refuge Complex. Observation, Photography, and Interpretation C1. Same as B1 (develop visitor services plan).

Observation, Photography, and Interpretation C2. Same as B2 (hire outdoor recreation planner).

Alamosa and Monte Vista National Wildlife Refuges. Observation, Photography, and Interpretation C3. Same as A1 (maintain existing programs and facilities).

Observation, Photography, and Interpretation C4. Same as A2 (maintain auto tour route and nature trails).

Observation, Photography, and Interpretation C5. Within 5–7 years, from about July 15 through February 28, open about 5.4 miles of existing trails or Service two-track roads on the Alamosa Refuge that are currently available only to hunters for walking or other compatible access such as bicycles or skis (figure 20).

Observation, Photography, and Interpretation C6. Within 4 years, upgrade the existing contact station and visitor center on the Alamosa Refuge, focusing on environmental education and serving administrative needs such as offices and storage. Replace outdated interpretive panels in the visitor center, at kiosks, and along the auto tour route. Improve part of the Rio Grande Nature Trail to be accessible.

Observation, Photography, and Interpretation C7. Within 5 years, improve the Meadowlark Nature Trail on the Monte Vista Refuge with information about trail length, make accessibility modifications, and provide a viewing blind.

Rationale C1-C7. Due to changes in water management, some of the observation facilities would be removed and other observation locations may need to be shifted.

Strategies C1–C7:

- Inventory, maintain, and replace signs, as needed.
- Maintain the auto tour route.
- Coordinate partners and other specialists to conduct guided interpretive tours.
- Continue to cosponsor special events related to wildlife and habitat conservation.

Baca National Wildlife Refuge. Observation, Photography, and Interpretation C7. (Similar to alternative A).

Objectives for Observation, Photography, and Interpretation, Alternative D

The objectives and strategies would be geared toward maximizing and emphasizing compatible public use.

All Refuges in the Refuge Complex. Observation, Photography, and Interpretation D1. Same as B1 and C1.

Observation, Photography, and Interpretation D2. Within 2 years, hire two outdoor recreation planners for the refuges, and by year 5, hire an environmental education specialist.

Observation, Photography, and Interpretation D3. Within 5 years, conduct a visitor experience survey to obtain an estimate of the number of visitors and their desired needs and experiences for wildlife observation.

Alamosa and Monte Vista National Wildlife Refuges. Observation, Photography, and Interpretation D4. By year 15, increase participation in wildlife observation, photography, and interpretive activities by 25–40 percent (approximately 4,000–6,000 more visits over alternative A).

Observation, Photography, and Interpretation D5. By year 15, improve the quality and increase the number of programs or facilities for wildlife observation, photography, and self-guided and staff-dependent interpretation by approximately 15–25 percent over alternative A.

Observation, Photography, and Interpretation D6. Allow year-round wildlife observation and photography within designated areas.

Observation, Photography, and Interpretation D7. Within 3 years on the Alamosa Refuge, staff the visitor center 4–5 days per week, and within 5 years, design and build new interpretive exhibits.

Observation, Photography, and Interpretation D8. Within 3 years on the Alamosa Refuge, extend the auto tour route to the east, and within 8 years, improve the roads in the southern part of the refuge and develop signs along an added auto tour route loop. Enhance both routes with more pull-offs and interpretive media (figure 23).

Observation, Photography, and Interpretation D9. At the Alamosa Refuge, within 5 years, build approximately 4 more miles of trails and roads along the Rio Grande so that the south and north portions of the refuge are connected by the trail. Within 5 years, incorporate viewing blinds, observation platforms, viewing scopes, fishing access, and a southern trailhead into the new trail.

Observation, Photography, and Interpretation D10. At the Alamosa Refuge, within 5 years, develop several viewing towers to orient visitors to the refuge and facilitate wildlife observation.

Observation, Photography, and Interpretation D11. Within 5 years, begin working with partners and the communities of Alamosa and Monte Vista to connect the refuges to the town trail systems.

Observation, Photography, and Interpretation D12. Same as B7 (new visitor center and offices). By year 15, design and build a new visitor center and office at the Monte Vista Refuge for the entire refuge complex. Link trails from the new visitor center with connections to the Meadowlark Nature Trail, the auto tour route, and other destinations. Repurpose or remove the existing buildings at the headquarters office at the Alamosa Refuge and construct volunteer recreational vehicle pads.

Baca National Wildlife Refuge. Observation, Photography, and Interpretation D13. Within 8 years on the Baca Refuge, extend the auto tour route to the south with more pull-offs and interpretive media (figure 24).

Observation, Photography, and Interpretation D14. By year 8–10, work with others to establish a multi-agency visitor contact station at the Baca Ranch headquarters and construct another trail that connects both the cattle and ranch headquarter areas. By year 10–12, work with NPS and others to build a trail connection to Great Sands National Park and Preserve (figure 24).

Rationale D1–D14. Under alternative D, we would maximize the compatible public use opportunities for all the alternatives to reach out to nonconsumptive user groups. In order to increase visitor days at the Monte Vista and Alamosa Refuges by 6,000 or more and reach 15,000 or more visitor use days at the Baca Refuge, we would need a minimum of three FTEs dedicated to visitor services (outdoor recreation planners plus an education specialist) along with more seasonal and temporary employees and a strong volunteer program. Strong partnerships with other agencies and local communities would be crucial for implementing this effort.

Strategies D1–D14 (all refuges). Same as B plus:

- Host bird identification events in conjunction with International Migratory Bird Day in May and other special events.

- Explore new areas to promote for wildlife observation and photography.

- Where feasible, develop a simple map within each visitor center where visitors can record what they saw and where (for example, a laminated refuge map that people can write on with a dry-erase marker).

- Develop materials such as exhibits and pamphlets as well as educational programs that explain the region's conservation priorities and the refuge resources.

Objectives for Environmental Education

Environmental education is a process designed to teach citizens and visitors the history and importance of conservation and biological and the scientific information about our Nation's resources. Within the Refuge System, we use on-site, off-site, and distance learning materials, activities, and programs (FWS 2006a) to achieve our objectives.

Objectives for Environmental Education, Alternative A

Education A1. Maintain limited educational programs such as the Monte Vista Crane Festival and Kids Crane Festival.

Rationale A1. Environmental education opportunities are limited because of lack of appropriate staff. The San Luis Valley has a variety of opportunities for environmental education. Refuge wetlands provide a unique place to explore nature and science. Wetland programs exist on other refuges and could be expanded and adapted to our refuges.

We would maintain existing levels of environmental education and interpretation that include sporadic, internally led environmental education programs as staff or volunteer time allows. For

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School children participate in an environmental education class on Alamosa Refuge.

example, the Alamosa Refuge used to be staffed half days during the week depending on staff availability, and there is a K-5 curriculum for wetland education; (Friends of the San Luis Valley National Wildlife Refuges 2013).

Strategies A1:

- Work with the Friends group to put on the Monte Vista Crane Festival, Kid's Fishing Day, and Kids Crane Festival.

Objectives for Environmental Education, Alternative B (Draft Proposed Action)

Under this alternative, the environmental education program would be expanded.

All Refuges in the Refuge Complex. Education B1. Within 5–10 years, working with our partners and area educators, improve the existing environmental education programs on- and off-refuge by developing an Educator's Guide and more curriculum-based educational programming. Provide refuge-taught environmental education programming to a minimum of two school or teacher training groups per year.

Education B2. Within 3 years, form partnerships with local school districts and other educational organizations and collaboratively develop curriculum and programming. By year 5–7, launch the environmental education program with school districts and teachers throughout the refuge complex.

Education B3. Work with partners to update existing environmental education curricula tailored to the refuge complex; potential partners include BLM, BOR, the State of Colorado, Project Wild, Project Wet, Nature Learning, and Project Learning Tree. Include potential topics such as hydrology, sandhill cranes, climate change, and riparian ecosystems.

Alamosa and Monte Vista National Wildlife Refuges. Education B4. At the Alamosa Refuge, use the existing visitor center for environmental education programming. By year 5, install new accessible kiosks, retrofit the building to be accessible to all users, and develop interpretive panels for inside and outside the building. By year 10, establish a discovery station geared toward school groups and young visitors that provides hands-on learning and nature play opportunities.

Baca National Wildlife Refuge. Education B5. By year 5–8, host environmental education and interpretive programs and activities six times per year, and increase programming if demand exists.

Rationale B1-B5. We support connecting people with nature through various initiatives such as "Let's Go Outside" (FWS 2013i). Louv (2005) highlighted the importance of connecting children with nature, contending that the lack of nature, or "nature deficit disorder," in the lives of today's wired generation contributes to disturbing childhood trends such as rises in obesity, attention disorders, and depression. Because the refuge complex is near the communities in the area, it offers unique opportunities for engaging children and adults in the area. With a university and a college adjacent to the Alamosa Refuge in Alamosa, we have an opportunity to partner and work with the students and faculties of these schools.

To achieve our objectives, we would need to hire an outdoor recreation planner. We need to also develop a visitor services plan that identifies the elements of an environmental education program for the refuge. Previously, the refuge complex had an outdoor recreation planner, but that position was cut as a result of budget cuts. With more staff, we could increase in the number of environmental education programs that we could offer. The programs would focus on wildlife biology and habitat needs and would update existing curricula to highlight refuge issues. Because environmental education is curriculum-based and labor intensive, initial efforts would be limited to the Alamosa Refuge, but these efforts could be expanded to include the other refuges in the complex.

Strategies B1–B5:

- In addition to school districts, work with migrant schools, Boys and Girls Clubs, La Puente, and other groups.
- Increase curriculum-based opportunities for environmental education.
- Work with other Federal agencies to support an interagency environmental education specialist for the San Luis Valley.
- Work with Teaching Environments Naturally CPW.
- Partner with NPS to provide environmental education in the local area. For example we could have a NPS education specialist lead programs at the Alamosa refuge, and we could adopt their online curriculum and wetland educator's guide. In turn we could lead an event at the Great Sand Dunes (such as during July Wetlands Month).

- Develop an interpretive timeline that communicates the story of the Baca property from the Luis Maria Baca Grant #4 to conservation by TNC, NPS, and FWS in 2004–2005.

- Pursue "Connecting People with Nature" grants.

- Look into participating in other events and programs outside the refuge that have an educational focus, such as Beaver Creek Youth Camp, Ducks Unlimited Green-Wing Day, and Water Fest.

- Recruit more volunteers and use volunteers and seasonal employees to staff facilities and support environmental education programming.

- Link refuge complex Web site to other online educational resources and Friends group curriculum.

- Develop an environmental education program as part of the visitor services step-down plan.

- Align teacher- and refuge-taught school programs with State and local educational standards.

- Find gaps in environmental education materials and programs, conduct a visitor experience survey, and identify other themes to expand through improved programming.

- Promote teacher-taught and refuge-taught programming that incorporates the "Children in Nature" initiative in both structured and unstructured ways. Encourage family visits and family awareness of the refuge and the Refuge System. Promote programs to get all ages of children outdoors.

- Respond to requests for technical help with curriculum-based environmental education such as Range Days, Bio-Blitz, Envirothon, and Field Days.

- Use the refuge Web site to promote environmental education; include a downloadable podcast.

- Annually offer two teacher workshops to all interested school districts in the San Luis Valley to promote refuge-based (local community) and regional-based information.

Objectives for Environmental Education, Alternative C

We would maintain limited interpretive and environmental education programs within the refuge complex, including providing limited programming on the Baca Refuge.

All Refuges in the Refuge Complex. Education C1. Maintain limited on-site interpretation and environmental education opportunities.

Alamosa and Monte Vista National Wildlife Refuges. Education C2. Continue to take part in the Kids Crane Festival and make adjustments based on changes to habitat management.

Baca National Wildlife Refuge. Education C3. Offer about 10 guided tours per year.

Education C4. At the Baca Refuge, establish a visitor contact station at the Ranch Headquarters and host about six programs (environmental education and interpretive). Increase the number of programs after year 5 if demand exists.

Rationale C1–C4. Because most of the emphasis, including resource allocation, would be focused on habitat and wildlife management, there would be less focus on providing environmental education opportunities, but current programs would be continued. Nonetheless, some limited environmental education opportunities could be established on the Baca Refuge.

Strategies C1–C4:

- Work with partners and volunteers to increase off-site programming.

- Focus on interpreting restoration efforts and new approaches to management.

Objectives for Environmental Education, Alternative D

Opportunities for environmental education would be maximized.

All Refuges in the Refuge Complex. Education D1–D3. Same as B1–B3 plus, within 5–10 years, expand the quantity of hands-on environmental education programs (on- and off-refuge) by up to 20 school visits per year. Offer regular interpretive programming (1 per month) which would include workshops, presentations, guided tours, or activities geared toward families and children. Seek funding for and produce a refuge complex orientation and educational film (or animated slideshow) to be shown at the visitor facilities and available online.

Education D4. Establish a San Luis Valley-wide auto tour route that connects the auto tour routes available at each of the three refuges and interprets some of the valley's natural resources, cultural sites, and views experienced when driving between the refuges. There could be a physical brochure and travel itinerary or an online tour description.

Alamosa and Monte Vista National Wildlife Refuges. Education D5. Same as B4.

Baca National Wildlife Refuge. Education D6. Same as B5 plus: By year 15, convert the barn on the Baca Refuge to an environmental education and interpretation center. Use it for youth programming, camps, classroom space, and exhibits as well as interagency orientation.

Rationale D1–D5. Several actions would be similar to those under alternative B; however, because public use is emphasized under this alternative, we would substantially expand the refuge complex's environmental education program with a particular focus on threatened and endangered species, reintroduced species, and restoration activities. Existing curricula would be modified to highlight these issues, and several new curricula would be developed in compliance with State standards. Because it would be more labor-intensive, a minimum of two FTEs would be needed as well as seasonal employees and volunteers.

Strategies D1–D5. Same as B plus:

- Invest in more innovative technologies and digital media to interpret the stories of the refuges for visitors both onsite and offsite.
- Work with partners to create up to 15 environmental education curricula unique to the refuge and update existing curricula tailored to the refuge.
- Request that researchers working at the refuge share information they collect through presentations at schools.

Objectives for Outreach

Outreach to the local communities helps to educate people about the refuge complex and its needs. Outreach involves communication between the refuge and the public, interested groups, local communities, and city, county, State, and Federal officials. It may include formal meetings or informal discussions with visitors or landowners, as well as news releases, organized programs, tours, and presentations.

Objectives for Outreach Alternative A

All Refuges in the Refuge Complex. Outreach A1. Continue outreach activities as staff resources permit.

Rationale A1. Our outreach efforts help us communicate with the public and other agencies and organizations about the work we do.

Strategies A1:

- Take part in State and local events such as State, county, and school career fairs. Make presentations as requested.
- Recruit volunteers to support staff.
- Seek grants in partnership with others to pay for special events or programs.
- Keep the public informed about refuge programs and activities via Web site.

Objectives for Outreach, Alternative B (Draft Proposed Action)

Many of the outreach activities would be in addition to existing efforts, as listed under alternative A.

All Refuges in the Refuge Complex. Outreach B1. Develop an outreach plan as part of the visitor services plan. Increase the visibility of the refuge complex and help visitors find the refuge with improved roadside signage and directional signs on roads that border the refuge.

Outreach B2. By year 5, develop a new refuge complex map and brochure that highlights the refuge's resources, public use opportunities, and interpretive themes. Develop separate general brochures for each refuge, highlighting specific regulations, activities, and points of interest.

Outreach B3. Within 5 years, update and improve the Web site and social media to keep information fresh and current.

Outreach B4. Maintain and strengthen links with area tourism centers and other tourism sites such as Fort Garland, Great Sand Dunes National Park and Preserve, and the Colorado Welcome Center to make sure that more visitors are aware of the refuges and that correct information is distributed.

Rationale B1–B5. Greater outreach would help us to target new audiences, recruit more volunteers, and help get our conservation message out to larger audiences. The outreach message would be focused on the refuge's goal of increasing wildlife resources and restoring habitat.

Strategies B1–B5:

- Incorporate refuge maps into kiosks at trailheads and other refuge entrance points to help orient visitors. Include a context map of the San Luis Valley, so visitors know that the refuge they are at is part of a larger complex.
- Use events like the Monte Vista Crane Festival to increase awareness about and visibility of the refuge complex.
- Use written translation and guided tours offered in Spanish.
- Update the Web site to provide trip planning, weather and safety information, and information on events or activities.
- Work with the Colorado Tourism Office, local chambers of commerce, and the Sangre de Cristo National Heritage Area to promote the refuges and their resources.
- Actively take part in State and local events, such as State, county, and school career fairs.
- Annually conduct two information-sharing events with the media, such as interviews, public service announcements, and written articles, and provide information to chambers of commerce, congressional contacts, and tourism outlets.

Objectives for Outreach Alternative C

Generally, outreach efforts under this alternative would be similar to those in alternative B.

All Refuges in the Refuge Complex. Outreach C1–C4. Same as B1–B4.

Rationale C1–C4. Same as B.

Strategies C1–C4. Same as B.

Objectives for Outreach, Alternative D

Outreach efforts under alternative D would be increased over those under alternatives B and C.

All Refuges in the Refuge Complex. Outreach D1–D4. Same as B1–B4.

Outreach D5. By year 5, work with Friends group to develop and circulate an E-newsletter twice a year. The newsletter would contain information on activities, events, resources, and safety.

Rationale D1–D5. Same as B.

Strategies D1–D5. Same as B plus:

- Place greater emphasis on outreach for both communicating wildlife and habitat goals as well as for increasing visitation to the refuge.
- Annually conduct five information-sharing events with the media, such as interviews, public service announcements, and written articles, and provide information to chambers of commerce, congressional contacts, and tourism outlets.

Objectives for Commercial Recreation

Commercial recreational uses are uses of a national wildlife refuge where an economic gain is derived. Commercial recreational uses of a refuge may be compatible if they directly support a priority public use, or if they are specifically authorized by a statute. Examples of commercial uses are concession-operated activities or commercial outfitting, photography or guiding. Commercial uses must be compatible with the mission of the Service, the Refuge System, and the purpose for which the refuge was established. Commercial uses that are not compatible are not allowed.

Objectives for Commercial Recreation, Alternative A

Commercial Recreation A1. Continue to allow commercial use only by special permit.

Rationale A1. We receive few requests for commercial recreation opportunities and they can easily be handled on a case-by-case basis.

Strategies A1.

- Require all photographers to allow us to use photos for refuge complex purposes.

Objectives for Commercial Recreation, Alternative B (Draft Proposed Action)

Commercial Recreation B1. Same as A1 plus allow for additional limited commercial uses under special use permits such as horseback rides or photography.

Rationale B1. To increase opportunities for visitor services, we would consider expanding commercial permits. For example, we could allow the stables at the nearby Baca Grande subdivision to take rides into Baca Refuge, or allow for some professional photography, classes, nature tours, or packing elk out of an area for a hunter.

Strategies B1. Same as A1 plus:

- Determine whether a special use permit or concession permit is needed on a case-by-case basis.

Objectives for Commercial Recreation, Alternative C

Commercial Recreation C1. Same as A1.

Rationale C1. Same as A1.

Strategies C1. Same as A1.

Objectives for Commercial Recreation, Alternative D

Commercial Recreation D1. Same as B1.

Rationale D1. Same as B1.

Strategies D1. Same as B1.

Partnerships and Refuge Operations

We work in partnership with a number of Federal, State, and local governmental agencies throughout the San Luis Valley. We also work with other conservation partners and stakeholders to accomplish our management goals and objectives. Our facilities, infrastructure, and staff facilitate our ability to accomplish the conservation work we do.

Objectives for Partnerships

The refuge complex and its resources are within the larger landscape of the San Luis Valley and the adjacent high mountains. Partnerships, including agreements with landowners next to the refuges and other interested agencies and stakeholder groups, are essential in achieving our habitat, wildlife, and visitor services objectives.

Objectives for Partnerships, Alternative A

All Refuge in the Refuge Complex. Partnerships A1. Maintain existing partnerships including our Friends group (see section 3.17 for a list of our many partnership organizations). (Same as B1, C1, and D1.)

Partnerships A2. Continue to work with the Partners program to support privately owned habitats vitally important to the refuge complex and the Southern Rockies Landscape Conservation Cooperative (see chapter 1, figure 4). (Same as B2, C2, and D2.)

Rationale A1–A2. Currently, the Service works cooperatively with many agencies and jurisdictions; these efforts have been quite successful and would continue. For example, the sheer size of the Baca Refuge and its juxtaposition to other conservation entities in the Great Sand Dunes ecosystem has required a Service commitment to working with neighboring agencies, local groups, and individuals on common areas of interest.

Strategies A1–A2:

- Protect habitat through fee-title and easements and by participating in partnerships with other land conservation trusts and entities.
- Integrate refuge planning with the Partners program.

Objectives for Partnerships, Alternative B (Draft Proposed Action)

All Refuges in the Refuge Complex. Partnerships B1. Same as A1, C1, and D1.

Partnerships B2. Same as A2, C2, and D2.

Partnerships B3. Establish new partnerships, such as with local universities, local trails groups, and many other organizations that can help us achieve our habitat, wildlife, and visitor services objectives.

Rationale B3. Because of the central location of the refuges, we have numerous opportunities to reach out and establish new partnerships to assist us in accomplishing our objectives and getting the message out about the work of the Service.

Strategies B3:

- Work with our partners to share resources.

Baca National Wildlife Refuge. Partnerships B4. Work with NPS to interpret and manage the Pedro Trujillo Homestead.

Rationale B4. The Pedro Trujillo homestead is a Hispanic homestead located on the Baca Refuge that dates to the mid-19th century. It was designated as a National Historic Landmark in 2012 as a representation of the expansion of Hispano-American settlement in the American Southwest following the 1848 Treaty of Guadalupe-Hidalgo (National Park Traveler 2012). Because the NPS has substantial expertise in interpreting historic properties, including those in the San Luis Valley, it is a logical partner; the NPS has expressed interest in partnering with us to interpret this significant landmark. Because of its remote location and limited staff resources, limited access or guided tours would be necessary to protect the site from vandalism.

Strategies B4:

- Continue to work with the Baca branch of the Friends group to achieve refuge objectives.
- Work with partners in Monte Vista and Alamosa to link the towns to the refuges via a trail.
- Pursue joint visitor services programming with other agencies such as NPS and BLM.
- Work actively with partners such as the Colorado Wetlands Program, Ducks Unlimited, and Colorado Division of Water Resources to maximize efficiencies in water management.
- Pursue an interagency environmental education position with other agencies.

Objectives for Partnerships, Alternative C

Partnerships C1. Same as A1, B1, and D1.

Partnerships C2. Same as A2, B2, and D2.

Partnerships C3. Pursue more partnerships to support restoration and natural resource conservation.

Rationale and Strategies C1–C3. Similar to B1–B4.

Objectives for Partnerships, Alternative D

Partnerships D1. Same as A1 and C1.

Partnerships D2. Same as A2, B2, and C2.

Partnerships D3. Seek more partnerships with other agencies and organizations that would help us facilitate better wildlife-dependent recreational opportunities and visitor service.

Partnerships D4. Work with NPS, BLM, the Sangre de Cristo National Heritage Area, and other agencies and organizations to incorporate the three refuges into heritage tourism programming.

Rationale D1–D4. The Sangre de Cristo National Heritage Area encompasses the refuge complex and NPS lands, private lands, and communities. One of the primary interpretive themes is how the interplay of wind, water, and sand have shaped the San Luis Valley's unique landforms and contributed to its biological diversity (NPS 2012b). There is a lot of opportunity to share expertise with our partners in wetland interpretation.

Strategies D1–D4. Similar to B.

Objectives for Refuge Operations

Refuge operations include management of facilities, structures, and other land and water use. The refuge relies on staff, equipment, and facilities to carry out both the day-to-day operations and the long-term programs such as land acquisition. The following objectives describe how the Service uses money and staff to meet the refuge complex goals.

Objectives for Refuge Operations, Alternative A

All Refuges in the Refuge Complex. Operations and Staffing A1. Over 15 years, maintain staff levels as identified in table 7, section 3.20.

Rationale A1. There are 11.5 FTE positions as well as several seasonal or term positions at the refuge. (Refer to table 7.) These are the general staff levels that would continue to be funded over 15 years, although all funding is dependent on annual funding allocations.

Strategies A1:

- Spread limited staff resources across the refuge complex to accomplish habitat objectives and provide limited public use.

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A water structure along Crestone Creek. There are many infrastructure needs for managing water more efficiently across the refuge complex.

Alamosa and Monte Vista National Wildlife Refuges. Operations and Staffing A2. Maintain 2.5 miles of auto tour route on the Monte Vista Refuge and 3.2 miles on the Alamosa Refuge; provide about 9 miles of trails and two-track roads available for hunting only on the Monte Vista Refuge and 10.5 miles on the Alamosa Refuge; and provide a 0.25 mile nature trail (nature trails include some interpretation) on the Monte Vista Refuge and 2.6 miles of nature trails on the Alamosa Refuge.

Rationale A2. With existing staff resources, we would continue to provide limited opportunities for access on the Monte Vista and Alamosa Refuges on the existing trail and road network. Opportunities for wildlife observation would be limited outside of the existing auto tour route, access roads, and nature trails. Hunters would continue to access hunt areas during the hunting season.

Strategies A2:

- Institute seasonal closures as needed.

Baca National Wildlife Refuge. Operations and Staffing A3. Continue to provide limited access to the Baca headquarters area and approximately 9 miles of roads that cross refuge lands.

Rationale A3. With limited staff and funding, we would continue to keep the Baca Refuge closed. Only limited access to the headquarters area or along county roads that cross refuge lands would be permitted.

Strategies A3:

- Post signs and provide some limited information and interpretive signs or kiosks.

Objectives for Refuge Operations Alternative B (Draft Proposed Action)

All Refuges in the Refuge Complex. Operations and Staffing B1. Same as A1 plus: Over 15 years, to accomplish habitat and public use objectives, justify and obtain new FTEs for the following positions: Convert one office support assistant from term to full-time for refuge headquarters; add one office support assistant for the Baca Refuge; add one outdoor recreation planner for the refuge complex; add one hydrologist for the refuge complex; add one wildlife biologist for the refuge complex; change one biological technician from Alamosa to refuge headquarters; add one biological technician for the refuge headquarters; add one refuge manager for the Monte Vista Refuge; add one supervisory range technician for interagency fuel planning (GS-9); convert existing ½ FTE for interagency fire technician to full-time (GS-7); add one FTE (two seasonal ½ FTEs) tractor operators for refuge headquarters and add ½ FTE tractor operator for Baca Refuge; and more seasonal positions.

Operations and Staffing B2. By year 7–10, replace all unreliable heavy equipment and vehicles.

Rationale B1–B2. In order to open the Baca Refuge to public access and to provide more opportunities across the refuge complex, we would need to increase refuge complex staff (table 7) and several seasonal positions. When the Baca Refuge was authorized and established, greater operations funding did not accompany this significant acquisition of Refuge System lands. Existing staff from the Monte Vista and Alamosa Refuges assumed the responsibility for managing this added land. In addition to opening Baca Refuge to hunting and wildlife-dependent recreational uses and increasing staff for the other refuges, other key staff resources needs include increased law enforcement presence, a refuge manager for the Monte Vista Refuge, and an outdoor recreational planner. Given the central location of the refuges to the towns of Alamosa, Monte Vista, and Crestone, we believe it is necessary to have an outdoor recreation planner for the refuge complex's visitor services program. Although the refuge complex is fortunate to have an active Friends group, a Service position devoted to this task is needed to manage active visitor services and volunteer programs for the refuge complex. Currently, the refuge manager for the Alamosa and Monte Vista Refuges manages this program in addition to the other habitat and management duties.

In order to achieve our habitat or visitor services objectives, we would also replace some of our heavy equipment and other vehicles that are old, unreliable, and costly to maintain.

Strategies B1-B2:

- Prioritize the positions and equipment that are needed to achieve our habitat and visitor services objectives.

Alamosa and Monte Vista National Wildlife Refuges. Operations and Staffing B3. By year 15, build a visitor center and refuge complex headquarters at the Monte Vista Refuge (Same as alternative D).

Operations and Staffing B4. Same as A2 plus: Within 5–7 years, redesign the auto tour route on the Alamosa Refuge to provide an alternative route to access the Bluff Overlook off the existing auto tour route (about 2 miles and follows existing Service road). By year 3, on the Alamosa Refuge, allow for seasonal access for biking and walking in areas that have been traditionally opened only to hunters during hunting season. Using existing roads or trails, open 6 more miles of nature (interpretive) trails on the Alamosa Refuge, including a trail link from Alamosa to the refuge. Open about 1 mile of new interpretive trail on the Monte Vista Refuge. Open existing trails in the hunting area on the Monte Vista Refuge to visitor access seasonally (July 15–February 28) for foot and bicycle access.

Operations and Staffing B5. By year 15, repurpose the Lillpop house on the Alamosa Refuge, which serves as the existing headquarters office, as well as the single and double-wide trailer with a small bunkhouse and two recreational vehicle sites for volunteers.

Operations and Staffing B6. By year 15, improve the recreational vehicle sites for volunteers to make them accessible for larger motorhomes and provide thermal breaks.

Operations and Staffing B7. Within 10 years, rehabilitate the existing Alamosa visitor and environmental education center to be fully accessible. Update all fixtures to environmentally friendly models.

Operations and Staffing B8. Within 10 years, rehabilitate all living quarters to be more energy efficient.

Operations and Staffing B9. Within 2–3 years, identify accessibility needs for trails, blinds, kiosks, pullouts, observation platforms, and other visitor services facilities.

Operations and Staffing B10. Within 2–3 years, identify new or replacement infrastructure for managing water more efficiently (refer to habitat and water resources objectives) and set priorities for replacement.

Rationale B3–B10. Currently the operations office for the refuge complex is located at the Lillpop office on Emperius Road in Alamosa. The building, a former house, is not ideally designed for an office environment. For example, the ventilation of the current office is not always conducive to a productive working environment for staff. The building is not universally accessible for members of the public or employees with disabilities. It is tucked away from visitors and members of the public who may need information or services. Current access to the building is down Emperius Road, which requires an unsafe railroad crossing (blind crossing with no gates) and presents a safety hazard for visitors and employees that is difficult to remedy.

Much of the refuge complex visitation occurs at the Monte Vista Refuge. The existing small office at the refuge does not serve as a visitor contact station, particularly when the refuge hosts the Monte Vista Crane Festival, which draws large numbers of visitors to the refuge. By building the refuge complex headquarters at the Monte Vista Refuge, including designing it to serve as a visitor center, it would solve a number of significant issues such as providing a central Service presence and improving safety, accessibility, energy efficiency, and ventilation.

Strategies B1-B10:

- Acquire funds for site planning, design, and construction for a new visitor center.
- Work with partners, volunteers, and regional office staff to find opportunities and efficiencies.
- Work with the county to find ways to improve safety on road into existing Alamosa headquarters area.

Baca National Wildlife Refuge. Operations and Staffing B11. At the Baca Refuge, within 1–2 years, begin a cleanup of the Baca Ranch headquarters area.

Operations and Staffing B12. Within 3 years, develop visitor and hunter access at the Baca Refuge to include an auto tour route, trails, and signed entry points from highways. (Refer to figure 18)

Operations and Staffing B13. Work with any future mineral developers to reduce disruption to visitors.

Rationale B11–B13. Primary access onto the Baca Refuge is located just outside of Crestone at the old ranch headquarters. To open the refuge to public use, the former boneyard needs to be cleaned up and access to the refuge provided. There are opportunities to partner with other agencies such as the NPS, USFS, and CPW to provide information in the northern parts of the San Luis Valley and achieve mutual objectives. Should future mineral development occur on the site, we would want to make sure that we minimize impact to refuge operations.

Strategies B11-13:

- Recruit volunteers to help with cleanup of the Baca Ranch headquarters area.
- Partner with other agencies.
- Work with the Cultural Resources Specialist in Region 6 to submit grant proposals to stabilize significant buildings and structures at the two Baca Ranch complexes.

- Work with mineral developers to reduce any effect on the visitor experience. Require mineral developers to site any facilities away from visitor access areas.

Objectives for Refuge Operations, Alternative C

All Refuges in the Refuge Complex. Operations and Staffing C1. Similar to alternative B1 plus: one engineering equipment operator for extensive habitat work.

Rationale C1. Overall, the staff requirements would be similar to alternative B, but the emphasis would be on habitat restoration work. We would be trying to improve our existing visitor services program on Alamosa and Monte Vista Refuges, but not to the level as described under alternatives B and D.

Strategies C1:

- Justify increases in staffing to accomplish refuge complex objectives.

Alamosa and Monte Vista National Wildlife Refuges. Operations and Staffing C2. S.Over 15 years allow for seasonal access for biking and walking on existing trails and roads that have been traditionally opened only to hunters.

Operations and Staffing C3. By year 15, renovate the existing environmental education and visitor contact station and make it fully accessible and update all fixtures (similar to B8).

Operations and Staffing C4. Same as B6
Operations and Staffing C5. Same as B7
Operations and Staffing C6. Same as B9
Operations and Staffing C7. Same as B9
Operations and Staffing C8. Same as B11

Rationale C2–C8. With the emphasis on restoration, staff resources would be used for habitat restoration work. We would minimize the number and extent of developed roads. Develop access in ways that least interfere with natural processes and hydrological function. However, there would still be a need to rehabilitate the existing environmental education and visitor contact station and living quarters; replace infrastructure across the refuge complex;and improve safety of the access into the headquarters area.

Strategies C2–C8:

- Work with partners, volunteers, and regional office staff to find opportunities and efficiencies.
- Work with the county to find ways to improve safety on road into existing Alamosa headquarters area.

Baca National Wildlife Refuge. Operations and Staffing C9. Similar to A3, except: On the Baca Refuge, provide for hunting access to achieve habitat objectives.

Rationale C9. On the Baca Refuge, staff resources would be needed to manage hunting access and to achieve habitat objectives.

Strategies C9:

- On the Baca Refuge, evaluate current roads and consider road removal to reduce habitat fragmentation.

Objectives for Refuge Operations, Alternative D

All Refuges in the Refuge Complex. Operations and Staffing D1 and D2. Similar to B1 and B2 plus: one outdoor recreation planner (two total for complex); one environmental education specialist; one law enforcement officer (GS 7/9); three maintenance workers and three seasonal employees for public use.

Rationale D1–D2. Similar to B1 and B2 except: Due to the increased levels of visitor access under this alternative and management of the bison operation by the Service, several more FTEs would be needed.

Strategies D1–D2:

- Similar to B1 and B2 except: there would be a greater emphasis on seeking partnerships, grant money, and creative ways to accomplish the habitat and visitor services objectives.

Alamosa and Monte Vista National Wildlife Refuges. Operations and Staffing D3–D10. Similar to B3–B10 plus: Expand the auto tour routes at the Monte Vista and Baca Refuges. Repurpose the Alamosa visitor contact station for use as an environmental education center with new interpretive media and interior and exterior exhibits (see figures 22, 23, and 24).

Rationale D3–D10. Access to the existing visitor contact station is on the existing auto tour route off of Highway 160 and does not have the same safety issues as the Lillpop office. Repurposing the Alamosa visitor contact station would provide an environmental education facility closer to Alamosa.

Strategies D3–D10:

- Similar to B.

Baca National Wildlife Refuge. Operations and Staffing D11–D13. Similar to B11-13, but there would be a lot more additional infrastructure required.

Rationale D11–D13. Similar to B11-B13 with the need for additional infrastructure.

Strategies D11–D13:

- Similar to B and seek creative solutions to accomplish the objectives.

Cultural Resources

Although many prehistoric and historic resources have been recorded within the refuge complex, the vast majority of the refuge lands have not been surveyed for cultural resources. Additional surveys and an assessment of the significance and appropriate management of the resources are needed to assure protection.

Objectives for Cultural Resources

The cultural resource objectives focus on adhering to current laws; protecting resources; maintaining partnerships; and providing education and outreach.

Objectives for Cultural Resources, Alternative A

Cultural Resources A1. Continue adherence to cultural resources laws including Section 106 of the National Historic Preservation Act; the Archaeological Preservation Act; and the Native American Graves Protection and Repatriation Act. Avoid adverse effects to significant resources when possible.

Rationale A1. The refuge complex contains many significant cultural resources, which we would continue to protect. Our Friends group and other members of the public have a lot of interest in the history of the refuge complex and are willing to help us with our preservation needs

Strategies A1:

- Offer educational outreach in the form of occasional presentations and limited use of signage.

- Work with Friends group and other members of the public to accomplish preservation and research objectives.

- Maintain law enforcement monitoring of known sites and sensitive areas.

- Within 10 years, complete an assessment of the two Baca Ranch complexes and determine whether the facilities could be used for other purposes.

Objectives for Cultural Resources, Alternative B (Draft Proposed Action)

Cultural Resources B1. Same as A1.

Rationale B1. Same as A1.

Strategies B1: Same as A1.

Cultural Resources B2. By year 15, develop a step-down plan (or assessment) for cultural resources at the Baca Refuge and develop partnerships with our friends groups and other stakeholders to protect cultural resources on the refuge

Rationale B2. All the refuges contain many significant prehistoric sites and historic areas, many of which have not yet been properly surveyed. The San Luis Valley has a rich history of Native American and Euro-American presence. Additionally, the Baca headquarters and purebred cattle headquarters area are eligible to be on the Register of Historic Places. The objectives listed above would enable the staff to better consider cultural resources in refuge operations and establish the priorities for cultural resources protection.

To increase the public's appreciation of and encourage support for cultural resources in the area, interpretation should be incorporated into the overall visitor services program. Long-term and past employees, as well as local residents and members of regional historic societies, can provide a wealth of information about the history of the refuge and the location of specific resources.

Strategies B2:

- Offer educational outreach in the form of occasional presentations and enhance use of signage, brochures, and the refuge complex Web site to disseminate information.

- Work with the Friends group and other stakeholder groups to accomplish preservation and research objectives. Develop partnerships to carry out targeted surveys and perform investigations to locate and preserve cultural resources. Work with neighbors and partners to acquire more information on the resources that can be used for interpretation.

- Increase law enforcement monitoring of known sites and sensitive areas.
- As necessary, complete reconnaissance surveys in response to Section 110 of the National Historic Preservation ActBring in guest speakers for presentations about refuge complex cultural resources.
- Develop exhibits and signs at the Baca Refuge interpreting cultural resources.
- Explore potential for interpretation at the cattle and ranch headquarters areas; cultural landscapes; and other outbuildings and cow camps.
- Provide guided tours.
- Increase dialogue with tribal representatives about locations of sites and collections.
- Recruit volunteers and partners to carry out targeted surveys and investigations to locate and preserve cultural resources.
- Develop partnerships with the Sangre de Cristo National Historic Area and other groups that have a cultural, historic, and archeological focus.
- Involve the Friends group in preparing National Register of Historic Places forms and surveys.
- Increase partnering with NPS, BLM, and USFS Heritage teams.
- Increase outreach to tribal and San Luis Valley residents to gain traditional insight into resource locations, collections from the refuges, and significance of these resources.

Objective B3. By year 15, stabilize and rehabilitate the house at Baca headquarters and fully record cow camps at the Baca Refuge.

Rationale B3: These are significant cultural resources on the Baca Refuge.

Strategies:

- Pursue a State Historic Fund Grant to pay for restoration of any demonstration buildings deemed suitable for reuse.
- Identify future uses for historic buildings and interpret cow camps.

Objectives for Cultural Resources, Alternative C

Cultural Resources C1. Same as A1.

Cultural Resources C2. Same as A except: offer more educational outreach in the form of occasional presentations and limited use of signage (less than alternative B).

Cultural Resources C3. By year 15, remove structures or buildings that are not significant.

Rationale. Because the focus of management would be to restore natural processes, some non-significant structures would be removed if they are intrusive on the landscape.

Strategies:

- Identify any structures and buildings that are not needed for refuge operations and remove them.

Objectives for Cultural Resources, Alternative D

D1–D3. Same as B1–B3.

Rationale D1–D3. Similar to alternative B1–B3.

Strategies D1–D3: Same as B1–B3 plus:

- Improve adherence to cultural resource laws and avoid adverse effects on significant resources when possible.
- Work with local schools to incorporate refuge prehistory, history, and historic preservation into the curriculum.
- Work with local and tribal educators to develop interpretive materials.
- Involve local universities in targeted surveys of high potential areas. Also use volunteers for survey projects.
- Involve various programs (Historicorps and universities) to evaluate, design, and perform restoration and adaptation work on the barns and main house at the Baca Refuge.
- Increase opportunities for public involvement with archaeological resources and restoration of historic buildings.

Research, Science, and Wilderness Review

The following objectives specifically address climate change, research, science, monitoring, and wilderness.

Objectives for Climate Change

Although there is considerable uncertainty about what effects can be attributed to climate change in the San Luis Valley, the magnitude, timing, distribution, and type of precipitation with corresponding effects on surface and ground water resources (see chapter 4) are changing. Our habitat management objectives, particularly re-establishing historic flow patterns, have been developed in response to changing conditions that we have been seeing across the refuge complex. (Refer to habitat objectives and water management objectives above.) We have also identified several specific objectives aimed at monitoring potential effects, communicating with the public, and reducing our carbon footprint.

Objectives for Climate Change, Alternatives A–D

Climate Change A1–D1. Incorporate and follow Secretarial Order 3289 (DOI 2009), Executive Orders 13514 and 13423, and policies as defined by 565 FW 1 in all facets of refuge management and operations including:

- landscape conservation design with biological outcomes at broader landscape levels as well as refuge-level scales
- landscape conservation that supports climate change adaptations by fish, wildlife, and plant populations of ecological and societal significance
- monitoring and research partnerships
- achieving carbon neutrality by 2020
- building capacity to understand, apply, and share terrestrial carbon sequestration science and work with partners to sequester atmospheric greenhouse gases while conserving fish and wildlife habitat at landscape scales
- providing educational and training opportunities for Service employees about the implications and urgency of climate change as it relates to the Service mission and engage them in seeking solutions
- public education
- partnerships – locally, nationally, and internationally

Climate change A2–D2. Study the effects of climate change on the refuge complex (including water availability, timing, duration, and volume), as it relates to wetland habitat health, sustainability, and wildlife use on the refuge complex.

Climate change A3–D3. Within 5 years, and as part of the visitor services stepdown plan, incorporate climate change messaging and themes in all of our visitor services programs. At least 70 percent of visitors to the refuge complex will understand the major climate change issues affecting our management of migratory birds and other wildlife within the refuge complex.

Rationale A1–A3 and D1–D3. The San Luis Valley, including the refuge complex, has experienced significant alterations over the last century, such as habitat loss and fragmentation, introduction of nonnative plants, increased presence of chemicals such as fertilizers and pesticides, and altered disturbance regimes such as the frequency, timing, and magnitude of fire, herbivory, and hydrology. These alterations have affected habitat quantity, quality, and sustainability. The effects of these stressors are likely being exacerbated by climate change, which is predicted to include higher temperatures; changes in the hydrologic cycle that affect aquatic species, including reduction in overall streamflow, an ongoing shift to earlier spring runoff, and warming of water temperatures; northward and upward shift in animal ranges, causing shifts in ecosystem composition; increased range and spread of wildlife pathogens; increase in plant mortality because of drought stress; increased risk of desertification in dryland ecosystems; and an overall reduction in biodiversity because of the above effects (Averyt et al. 2011).

While many of the current and potential effects of climate change on the habitats of the refuge complex are not known at this time, there have already been changes in hydrology. The wetland habitats have changed in recent years and will continue to change. Because hydrology is the primary abiotic factor that drives habitat quantity, quality, and function, we chose water availability, including timing, duration, and volume, as the best measure to monitor because it exerts the greatest influence on the vegetation composition and structure of refuge habitats as well as the availability of resources for wildlife populations.

Strategies A–D.

- Continue maintaining solar power production and recycling efforts, increase energy efficiency, and adopt other ways to reduce the refuge complex's carbon footprint.
- Integrate sustainability-based approaches into partnerships, contracts, and other external stakeholder efforts.
- Provide staff and external stakeholder training for sustainability-based principles and practices, social justice and equity, community development, and partnership performance standards.
- Establish performance benchmarks within the environmental management system (515 DM 4) as the essential first step, then create metrics and benchmarks for all other sustainability-based practices (environmental, social, economic, and community).
- Develop projects to retrofit facilities, infrastructure, equipment, and the vehicle fleet to maximize energy efficiency and production. Seek funding through Refuge Operations Needs and Deferred Maintenance databases, and other opportunistic and entrepreneurial funding sources.
- Reduce the carbon footprint of the refuge complex's operations and continue "greening" efforts to meet climate change initiatives, such as upgrading facilities to green standards, teleconferencing, carpooling, limiting excessive idling of vehicles and equipment, turning off lights and heat sources when not needed, and recycling.
- Monitor climate information from established weather stations throughout the San Luis Valley.
- Collaborate with the Colorado State Division of Water Resources, the Rio Grande Water Conservancy District, and other partners to monitor river flows and ground water levels throughout the Upper Rio Grande watershed.
- Collect information on the timing, volume, and duration of surface water delivery to each refuge.
- Collect information about the timing, volume, and duration of ground water use on the refuges.
- Annually, on each refuge, collect information on the amount of surface acres covered by water throughout the year as it relates to water inputs (both surface water delivery and ground water).
- Monitor changes in vegetative communities and wildlife use in all habitats.
- Install ground water monitoring devices on each refuge to monitor local ground water levels.
- Incorporate discussions about climate change and its effects on refuge habitats during public events such as the Monte Vista Crane Festival, Kid's Fishing Day, and other public interactions.
- Develop interpretive materials such as signs, brochures, and outreach that focus on climate change issues affecting migratory and breeding birds.

Research, Science, and Monitoring

In addition to research-related topics addressed in the sections above, this section identifies research issues specific to CCP implementation.

Objectives for Research, Science, and Monitoring Alternatives A–D

Research A1. Conduct research and monitoring efforts as opportunities arise and funding allows.

Research B1–D1. Conduct research, inventory, and monitoring activities specifically related to CCP implementation that are designed to assess and evaluate the effects of habitat management and public use. Determine wildlife and vegetation responses to various habitat management activities such as water management, rest, prescribed grazing, prescribed fire, and invasive weed control as well as public use in various habitats during different times of the year. Expand our knowledge of wildlife species diversity, abundance, and timing of use of refuge habitats under various vegetative and hydrologic conditions. The highest priority projects include:

- For focal bird species and other specific wildlife species, research the effects of habitat management activities on species richness and abundance during nesting, post-nesting, and migration periods throughout various habitats on the refuge complex. Determine how public use affects these species on the refuge complex.

- Conduct riparian plant surveys designed to measure the effects of large ungulate browsing and hydrologic conditions on willow and cottonwood reproduction, growth, spread, and survival and whether the objectives for riparian areas should be modified in any way.

- Survey riparian birds with an emphasis on the effects of plant structure, diversity, and extent on riparian bird species richness and abundance during nesting and migration periods.

- Survey vegetation with an emphasis on habitat management activities that are necessary to improve and promote habitat health, function, and sustainability.

- Conduct inventories related to wildlife species presence and absence, population trends, and level and timing of use on refuge habitats under various vegetative and hydrologic conditions.

- Coordinate with CPW to monitor status and trend for Rio Grande chub and sucker populations in Crestone Creek, North Crestone ditch, and Willow Creek as they relate to hydrology and other habitat conditions.

- Monitor aquatic macroinvertebrate richness and abundance as they relate to water management activities (such as timing of application, duration, and depth) and their effects on avian use.

- Monitor ground water levels and river and creek flows to assess effects on vegetation throughout the refuge complex's habitats, particularly riparian areas.

Rationale A1–D1. The Improvement Act requires us to "monitor the status and trends of fish, wildlife, and plants in each refuge." The Conserving the Future document (FWS 2011a) also describes specific recommendations for the need and importance of collecting scientific information relating to our refuges' wildlife, plant, and abiotic resources to use the principles of adaptive management. Under all alternatives, research, inventories, and monitoring would be used primarily to evaluate resource responses to habitat management and restoration activities such as water management; prescriptive grazing; prescribed fire; grass, shrub, and tree plantings; and invasive weed control. We would evaluate any effects such as disturbance or displacement that public uses may have on wildlife.

Depending on which alternative is selected, there may be slight differences on the focus of research and monitoring that would be conducted. Under alternative A, our abilities to conduct further research and monitoring activities would be limited to what we could accomplish within existing staff and funding levels or partnership opportunities. Under alternative B, our emphasis would be a blend alternatives B and C. Under alternative C, our emphasis would be on determining the effects of management activities on wildlife and plant resources that result from managing in a way that mimics natural ecological processes. Under alternative D, our emphasis would be on understanding the effects of increased public use on wildlife and plant resources. Under all alternatives, the data that are collected would be used to refine habitat and public use management strategies, and where necessary, to achieve resource objectives and reduce detrimental effects.

Research and monitoring projects would address such things as habitat use and life-history requirements for specific species and species groups; practical methods for habitat management and restoration; responses of vegetation and wildlife to various habitat management activities such as water management; prescriptive grazing; prescribed fire and invasive weed control; extent and severity of environmental contaminants; effects of climate change on environmental conditions and associated habitat and wildlife response; and responses of habitat and wildlife to disturbance from public uses. Projects may be species-specific or refuge-specific or they may evaluate the relative contribution of the refuges to issues and trends at a regional or national level. These projects would increase available scientific information and promote adaptive management on refuge lands.

Strategies A1–D1:

- Minimize wildlife disturbance habitat effects in any data collection. Collect the minimum number of samples required for analysis for identification and experimentation and use established scientific techniques for data collection and analysis.

Objectives for Wilderness

In keeping with the Service's planning policy, we are conducting a wilderness review as part of the CCP process. The review process has three phases including inventory, study, and recommendation (FWS 2008). We will use the findings of the study to


USFWS

Eastern portions of the Baca Refuge, adjacent to the Great Sand Dunes National Park and Preserve, would be recommended for wilderness protection in alternatives B, C, and D.

determine if we should recommend the area for designation in the final CCP. (Refer to appendix E.)

Objectives for Wilderness, Alternative A

Wilderness A1. Under this alternative, there would be no wilderness designation within the refuge complex.

Rationale A1. Currently, there are no designated wilderness study areas within the refuge complex, and we would not recommend any areas for protection. We would continue to manage the refuge units similar to the guidance found in the 2003 CCP and the 2005 conceptual management plan for the Baca Refuge.

Strategies A1: None

Objectives for Wilderness, Alternatives B, C, D

Wilderness B1, C1, and D1. Upon signing of the record of decision, manage the southeastern portions of the Baca Refuge which includes lower Deadman Creek, South Antelope Spring, and Sand Creek (see figure E1, appendix E) as a wilderness study area. Within 5 years, complete the inventory and review process, and forward final recommendations to the Director and the Secretary of the Department of the Interior.

Rationale B1–D1. Based on our review of the lands within the refuge complex, we found that the southeastern portion of the refuge (about 13,800 acres) possesses the following wilderness characteristics and values: 1) it is larger than 5,000 acres; 2) it is mostly intact and has few intervening roads and infrastructure; 3) it generally has little sign of human intervention and it shares a boundary with a current wilderness study area on Great Sand Dunes National Park and Preserve; 4) it is not easily accessible and is located nearly as far from regular human activity as possible on the valley floor; and 5) it is associated with the rare and significant Great Sand Dunes complex and contains unique native habitats and rich historic and prehistoric resources.

We divided the recommended land into several units (see above) to provide access for fire or other management purposes. Our review did not find areas on the Alamosa Refuge or the Monte Vista Refuge that meet the criteria for wilderness protection. (Refer to appendix E, table A.)

Strategies B1–D1:

- As necessary, conduct and complete a minimum tool evaluation for activities such as wildland fire, wildlife management, or other research-related activities.
- Ensure that wildland fire suppression activities can be carried out effectively.
- Maintain the ability to use prescribed fire and livestock grazing as needed to manage habitats in these areas.
- Maintain access to monitoring and stock wells for maintenance.
- Work with CPW to ensure optimal harvest of elk.

- Include those inholdings that are currently owned by TNC, once they have been acquired.

- Work cooperatively with NPS in managing shared wilderness values and characteristics on both park lands and refuge lands.

3.9 Foreseeable Activities

Cumulative effects on the environment are defined as the incremental effects of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such actions (40 CFR 1508.7). Reasonably foreseeable activities are actions and activities that are independent of the proposed actions in the CCP alternatives, but could result in cumulative effects when combined with the effects of the alternatives. These activities are anticipated to occur regardless of which CCP alternative is selected. Reasonably foreseeable actions, as defined by U.S. Environmental Protection Agency (EPA 1999), are not speculative; rather, they are actions that have been approved, are included in short- to medium-term planning and budget documents prepared by government agencies or other entities, or are likely to happen given the trends in the area.

This document identifies potential reasonably foreseeable actions that are analyzed for cumulative effects. A summary of the activity is provided, as well as a preliminary determination as to whether the activity is now reasonably foreseeable. That determination could change over the course of the analysis process, as some activities or actions become more certain over time.

Reasonably foreseeable activities within the San Luis Valley that have the potential to result in cumulative effects are described below in the following categories:

- Federal land management
- Land and infrastructure development
- Resource management and conservation
- Other activities or actions

The cumulative effects of these activities, when combined with the direct and indirect effects of the proposed CCP alternatives, are described in the impacts section for each resource in section 5.

Federal Land Management

The Rio Grande Natural Area was established on October 12, 2006, to conserve, restore, and protect the natural, historic, cultural, scientific, scenic, wildlife, and recreational resources of the 33-mile stretch of the Rio Grande between the southern end of the Alamosa Refuge and the Colorado-New Mexico State border. The BLM has convened a commission that is charged with preparing management plans for both the BLM and the private lands within the Rio Grande Natural Area. While the development of these management plans is reasonably foreseeable, the management direction that would be contained in the plans is not yet known (BLM 2013).

Southwestern Willow Flycatcher Critical Habitat Designation

On January 3, 2013, the U.S. Fish and Wildlife Service designated revised critical habitat for the southwestern willow flycatcher under the Endangered Species Act (FWS 2013b). About 1,975 stream kilometers (1,227 stream miles) were designated as critical habitat throughout the southwestern United States. In the San Luis Valley, three segments of critical habitat were designated on Federal lands along the Rio Grande and the Conejos River, totaling about 43.5 stream kilometers (27 stream miles) and including 8,345 acres within the Alamosa Refuge. The other two segments in the San Luis Valley are located on land owned by the BLM.

Great Sand Dunes National Park and Preserve Ungulate Management Plan

In November 2011, the National Park Service began the public scoping process for an ungulate management plan and EIS for Great Sand Dunes National Park and Preserve. The purpose of the plan and EIS is to establish a framework for the management of elk, bison, and other ungulates that supports the desired habitat conditions in the park and is compatible with conditions and management activities on neighboring lands (NPS 2011a). A draft plan and EIS is not anticipated until after 2014, with a final plan after that. Hunting is only permitted on the National Preserve in accordance with applicable federal and state laws. A general management plan was completed for the National Park and Preserve in 2007 (NPS 2007).

Management actions and potential effects of those actions that may result from this plan are not reasonably foreseeable at this time, since no draft plan alternatives or final plan actions have been released for public review.

Baca Mountain Tract and Camino Chamisa Project Management Plan

In 2009, the Rio Grande National Forest and Great Sand Dunes National Park and Preserve completed a plan that has management prescriptions for the Baca Mountain Tract and covers public motorized access across the park. The Baca Mountain Tract was formerly part of the private Baca Ranch and was added to National Forest System lands as part of the Great Sand Dunes National Park and Preserve Act of 2000, which also enlarged the national park and established the Baca Refuge. Under the approved plan, the management prescriptions are for bighorn sheep, elk, and deer winter range, and a Special Interest Area. The newly constructed road would provide public motorized access across the park from the Baca Grande Subdivision on the north boundary and would allow the vehicular transport of firearms, lawfully taken wildlife, and lawfully collected forest products for personal use (USDA and NPS 2009).

Blanca Wetlands ACEC Enlargement and Grazing Plan

The BLM's Blanca Wetlands Area of Critical Environmental Concern (ACEC) is located south of the Great Sand Dunes National Park and Preserve. It is part of a wetlands network of playa lakes, ponds, marshes, and wet meadows that was once more extensive within the closed basin of the San Luis Valley. The BLM has initiated a planning process and environmental assessment to analyze the effects of expanding the ACEC to include adjacent lands that share the ACEC values and characteristics, as well as grazing management within the ACEC. Expansion would occur through land acquisition from willing sellers (BLM 2013).

San Luis Lakes Wetland Restoration

The Blanca Wetlands has been identified as one of the most important areas in Colorado for shorebird migration and nesting. The BLM plans to restore up to 1,330 acres of wetlands within the South San Luis Lakes System. The plan is to irrigate up to 600 acres annually in South San Luis Lakes as well as place ditches and dikes where necessary to help distribute water and provide flow between basins. The proposed irrigation project area includes both TNC and BLM lands. The project is intended to provide habitat for shorebirds during migration and nesting seasons that would work in concert with what exists on the core area of the Blanca Wetlands as well as replace habitat that is being dried to help meet wetland objectives (BLM 2010).

Village at Wolf Creek Land Exchange

The Leavell-McCombs Joint Venture owns a private 288-acre inholding within the Rio Grande National Forest near the base of the Wolf Creek Ski Area. Over the years, four separate easements have been established between the ski area and the Leavell-McCombs Joint Venture to accommodate skiing and lifts on private lands in the inholding. Efforts to secure access to the inholding and develop a resort village had been unsuccessful, primarily because of litigation over environmental compliance requirements. In June 2010, the Leavell-McCombs Joint Venture proposed a land exchange, trading 177.6 acres of Leavell-McCombs Joint Venture land for 204.4 acres of Federal land. Completion of the land exchange would give the Rio Grande National Forest sensitive springs, wetlands, and fens, and since an access road connecting the ski area and the proposed village would be allowed, the joint venture would gain access to U.S. Highway 160. In August 2012, the USFS published a Draft EIS for the proposed land exchange (USDA Forest Service 2012, Blevins 2012).

Land and Infrastructure Development

Private Land Development

Over the past 10 years, development pressure in the San Luis Valley has been focused along the Rio Grande corridor, driven primarily by a demand for retirement and vacation homes along the river between Del Norte and South Fork (Rio Grande County 2004). One of the purposes of the Rio Grande Initiative conservation effort was to address the potential effects of increasing development (RiGHT 2006). While several new subdivisions within the greater Rio Grande corridor have been developed within recent years, the development pressure has somewhat abated since the beginning of the recession in 2008. Based on population forecasts developed by the Colorado State Demography Office, the San Luis Valley population is expected to grow by 45 percent by the year 2040 (Colorado State Demography Office 2011). This level of growth would likely contribute to increased private land development.

Crestone Baca Comprehensive Plan

The Baca Grande is a 14,000-acre subdivision next to the town of Crestone and immediately east of the Baca Refuge. In 2010, Saguache County initiated an update of the Crestone Baca Comprehensive Plans with a series of public meetings, community surveys, and planning commission work sessions. Issues that were identified through this planning process include the overuse of conditional use permits; inflexibility of land use; transportation; energy and communication infrastructure; and visual resource protection (Saguache County 2011).

Proposed Regional Transmission Lines

In 2008, the Tri-State Generation and Transmission Association (Tri-State) and the Public Service Company of Colorado (Xcel Energy) jointly proposed to construct, own, and operate the San Luis Valley–Calumet–Comanche Transmission Project. The proposed transmission line was envisioned to run from Alamosa east over La Veta Pass to Walsenburg, then north to the Comanche Power Plant near Pueblo (USDA and Rural Utilities Service 2009). The purpose of the proposed project is to increase transmission capacity and reliability, particularly in light of increased solar energy development opportunities. The proposed project generated considerable controversy because of its visual and environmental effects along the La Veta Pass corridor, including the privately owned Trinchera Ranch. In 2011, Xcel Energy dropped out of the project.

In January 2013, Tri-State and the San Luis Valley Rural Electric Cooperative announced that they were considering a new transmission line that would run from the southern end of the San Luis Valley in Conejos County south to reach the existing Carson transmission line near Espanola, New Mexico. This project is in its preliminary planning stages (Krizansky 2013).

Solar Energy Development

The San Luis Valley has been an attractive location for solar energy development facilities. Several solar facilities in Alamosa County are in place and at least one large project in Saguache County has been approved by Saguache County, with its implementation pending (Burnett and Jaffe 2012). In addition, the BLM has identified four areas on BLM lands in the valley within which the BLM would set priorities for and facilitate utility-scale production of solar energy and associated transmission infrastructure development: DaTilla Gulch (Saguache County), Fourmile East (Alamosa County), Los Mogotes East (Conejos County), and Antonito Southeast (Conejos County) (BLM 2012).

While the outcome of some of the current energy development proposals and future opportunities are speculative, it appears that future development of solar energy facilities in the Valley is a trend that is likely to continue.

Resource Management and Conservation

Private land conservation, habitat conservation, and ground water management are discussed in this section.

Private Land Conservation

Private land conservation efforts have played an important role in protecting and enhancing habitat and agricultural land in the Valley. Several organizations, including private land trusts, the Service, and the NRCS, have acquired conservation easements over private lands in the San Luis Valley. To date, more than 170,000 acres of private land in the Valley have been protected by conservation easements (including the Service's easement on the 76,700-acre Trinchera Ranch and 90,500 acre easement on the

Forbes Ranch, plus thousands of acres protected through other conservation efforts).

The Rio Grande Initiative is a partnership between the Rio Grande Headwaters Land Trust, Ducks Unlimited, TNC, the Colorado Cattleman's Agricultural Land Trust, and others to protect and restore riparian and wetland habitat on private lands along the Rio Grande. Since its initiation in 2006, the Rio Grande Initiative partners have raised more than $10 million and have protected more than 13,000 acres of land along the Rio Grande.

San Luis Valley Regional Habitat Conservation Plan

The purpose of the San Luis Valley regional habitat conservation plan (HCP) is to provide for the long-term conservation of the southwestern willow flycatcher and yellow-billed cuckoo while providing regulatory protection to the ongoing and routine agriculture, infrastructure, and conservation activities that are important for the social and economic well-being of the Valley. The HCP is being coordinated by the Rio Grande Water Conservation District in partnership with Alamosa, Conejos, Costilla, Mineral, Rio Grande, and Saguache Counties, local municipalities, and the State of Colorado. Each entity holds an Incidental Take Permit, issued by the Fish and Wildlife Service,that provides regulatory protection to private landowners and local units of government. The HCP estimates that about 270 acres of temporary habitat effects and about one acre per year of permanent effects would occur in any given year from the covered activities. These effects would be mitigated through conservation, enhancement, and management measures. Mitigation activities would be focused on private and State lands with high-quality habitat, and mitigation credits would offset the effects of the covered activities on an acre-for-acre basis. Habitat monitoring would track long-term trends and make sure that the habitat quality of mitigation lands is sufficient to offset effects. The HCP was finalized in late 2012 (Rio Grande Conservation District 2012) and is beginning to be implemented.

Ground Water Management Subdistricts

The Rio Grande Water Conservation District has spearheaded an effort to keep ground water pumping from depleting aquifers and to replace injuries to surface water users. In 2006, the first ground water management subdistrict (Special Improvement District No. 1) was formed to take action and help restore a balance between available water supplies and current levels of water use so that the San Luis Valley can continue to remain a viable agricultural community (Rio Grande Water Conservation District 2013a). Water levels of the unconfined aquifer within Subdistrict #1 (areas within the closed basin) are rapidly declining and are exceeding the total amount of recharge from natural sources and from diversions of the Rio Grande. This recent decline in the water table is a direct result of a prolonged drought and increased ground water consumption, and the rapid decline in the water table will only worsen unless the total consumption of ground water is reduced.

Several more subdistricts have been proposed, but are not yet recognized as legal entities:

- Subdistrict #2: San Luis Creek area
- Subdistrict #3: Conejos and San Antonio River
- Subdistrict #4: Alamosa River, La Jara Creek, and Carmel and Waverly area
- Subdistrict #5: Saguache Creek
- Subdistrict #6: San Luis Creek area

Other Activities or Actions

Other factors that may contribute to cumulative effects in the region include the Sangre de Cristo National Heritage Area and climate change.

Sangre de Cristo National Heritage Area

National Heritage Areas are designated by Congress as places where natural, cultural, and historic resources combine to form a cohesive, nationally important landscape. Through their resources, National Heritage Areas tell nationally important stories that celebrate our nation's diverse heritage. National Heritage Areas are lived-in landscapes. Completion of a management plan is required by the authorizing legislation for the Sangre de Cristo National Heritage Area. The management plan (NPS 2012b) has an inventory of the National Heritage Area's natural, cultural, and recreational resources, and presents approaches to conservation and recreation, historic preservation, and conservation of community and tradition. It offers ways to interpret National Heritage Area resources, and offers approaches to tourism, marketing, and community revitalization.

Climate Change

As per the Department of the Interior and Service policy on climate change (FWS 2010), this CCP and EIS addresses potential cumulative effects as a result of climate change.

3.10 Elements Considered but Eliminated from Further Consideration

During scoping and alternatives development, the Service, interested groups, and the public suggested several goals, alternatives, or elements of alternatives that were considered but eliminated from further analysis. These elements are discussed below.

Natural Predators

During the scoping process and as part of developing draft alternatives, we considered whether natural predators, specifically gray wolves *(Canis lupus)*, should be an element included under alternative C, Habitat Restoration and Ecological Processes, for managing elk populations on the Baca Refuge. As a keystone predator, the gray wolf is an integral part of the ecosystems to which it typically belongs (FWS 2013g; Nature Serve 2014). During the comment period on the draft alternatives (January–February 2012), we received many comments from the public about this element, both in support of this idea along with considerable opposition to it.

In Colorado, the gray wolf is an extirpated species that no longer exists in the wild in its historical habitat. It still exists elsewhere, most notably in the northern Rockies and in portions of southern Arizona and New Mexico. The last gray wolves were killed by about 1940 (CPW 2014) although in recent years, there have been reports of lone wolves dispersing into the State from the north, including one that was killed along Interstate 70 as recently as 2004 (CDOW 2004).

Wolves occupy a wide range of habitats. Originally, they fed on the vast herds of bison, elk, and deer, with rabbits, rodents, and carrion providing a secondary food source. Wolf territories are variable, ranging from 25–500 square miles (FWS 2013g). In comparison, at its widest points, the Baca Refuge is about 12 miles wide by 18 miles long (less than 216 square miles) on the valley floor, abutted by private lands to the north and west. Although bordered by the Great Sand Dunes National Park and Preserve to the east along with the Rio Grande National Forest to the North, the Sangre de Cristo Range is a narrow and linear mountain range (refer to figure 1), and it is not uncommon for elk to cross the range. For GMU 82 (part of the Baca Refuge), elk disperse widely during the winter months, often ranging from north of Baca Refuge to as far south as Fort Garland along Highway 160.

In the early 2000s, proposals were made to restore wolves to wilderness ecosystems of Colorado (CDOW 2005) where they could provide a natural check on populations of elk. These proposals were met with considerable opposition from many members of the public. In the early 2000s, the Colorado Division of Wildlife (now CPW) set up a working group to develop a wolf management plan. The group's final recommendations (not a management plan) were adopted in their entirety by the Colorado Wildlife Commission in May 2005 (CDOW 2005).

Colorado lies between two areas of existing wolf populations. To the north is the Northern Rocky Mountain gray wolf distinct population segment, and to the south is the Mexican gray wolf population, which is classified as an Experimental Population, Non-essential Population, found in portions of New Mexico and Arizona. Recently (2011 and 2012), the Service delisted the northern Rocky Mountain gray wolf distinct population segment in Montana, Wyoming, Idaho, eastern Washington, eastern Oregon, and north-central Utah. In 2013, the Service proposed removing the gray wolf from the list of endangered and threatened wildlife, and maintaining endangered status for the Mexican wolf by listing it as a subspecies *(Canis lupus baileyi)* (FWS 2013g). This proposed rule replaces a 2011 proposed action to remove protection for *Canis lupus* in all or portions of 29 eastern states. A final decision has not been made on this proposed rule.

Currently, the Service has no plans to reintroduce wolves into the State of Colorado (FWS 2013g). CPW is required to obtain legislative authorization for any reintroduction of wolves (Colorado Revised Statutes 33-2-105.5 and 33-2-105.7), and reporting requirements are extensive (CDOW 2005). In September 1989, the Colorado Wildlife Commission passed a resolution opposing reintroduction of the gray wolf (CDOW 2005), and the State has no plans to develop a recovery plan with specific actions taken to increase the number of wolves in the State (CDOW 2005). In considering potential reintroduction areas for wolves, Carroll et al. (2006) did not identify the adjacent Sangre de Cristo Range in Colorado as a potential reintroduction site and classified the San Luis Valley as unsuitable habitat.

Although unlikely at this time, given Colorado's proximity to other populations of gray wolf, individual wolves from either the north or south could eventually disperse onto the Baca Refuge. If this situation were to occur, the Service, in partnership with CPW, would monitor and manage the species.

After considering whether natural predators could play a significant role on the Baca Refuge, we found that it is not a viable solution for reducing the overall elk population under alternative C or any other alternative during the 15-year timeframe for implementing the major actions of this CCP.

3.11 Partnerships

We value the many partnership organizations we work with in the San Luis Valley. Many existing and potential partnership opportunities exist near the refuge complex, including:

- Federal agencies including BLM, NPS, USFS, NRCS, and the Partners program, which has been active in the San Luis Valley since 1990.
- Colorado Parks and Wildlife, Colorado Division of Water Resources, and other State agencies
- Rio Grande Water Conservation District, county commissioners, fire wardens, fire districts, weed districts, and sheriff's departments
- nongovernmental organizations including the invaluable work of the Friends of the San Luis Valley National Wildlife Refuges, TNC, Colorado Open Lands, Adams State College, Wildlife Conservation Society, Ducks Unlimited, Rocky Mountain Elk Foundation, Rio Grande Headwaters Land Trust, Colorado Cattleman's Agricultural Land Trust, American Farmland Trust, Sangre de Cristo Natural Heritage Area, Manitou Foundation, San Luis Valley Ecosystem Council. We could not accomplish our mission without the help of these organizations.
- neighboring private landowners, local communities, and chambers of commerce.

3.12 Monitoring and Evaluation

Adaptive management is a flexible approach to long-term management of biotic resources. Adaptive management is directed, over time, by the results of ongoing monitoring activities and other information. More specifically, adaptive management is a process by which projects are carried out within a framework of scientifically driven experiments to test the predictions and assumptions outlined within a CCP (see figure 28).

To apply adaptive management, specific survey, inventory, and monitoring protocols will be adopted for the refuge complex. The habitat management strategies will be systematically evaluated to determine management effects on wildlife populations. This information will be used to refine approaches and find out how effectively the objectives are being accomplished. Evaluations will include participation by Service staff and other partners. If monitoring and evaluation shows that a particular management approach is producing undesirable effects for target and non-target species or communities, alteration to the management approach will be altered and the CCP will be revised.

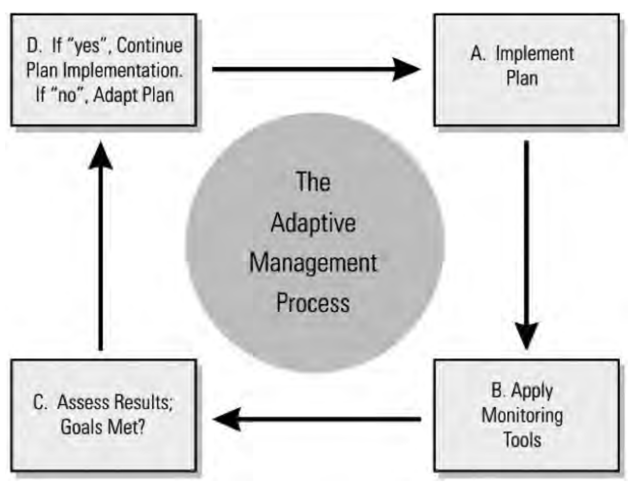

Figure 28. Map of the adaptive management process for implementing the CCP.

[redacted]

The final CCP will be reviewed annually to assess whether there is any need for revision. A revision would occur if significant information becomes available that makes change necessary, such as a change in ecological conditions. Revisions to the CCP and subsequent stepdown management plans will be subject to public review and compliance with NEPA. At a minimum, this plan will be evaluated every 5 years and revised after 15 years. Subsequent stepdown plans include:

- habitat management plan
- fire management plan
- visitor service management plan
- cultural resources management plan
- wilderness management plan
- water management plan

[redacted]

Refuge budgets generally include ongoing operations funds for staff, maintenance, and utility needs. Table 6 summarizes the estimated costs for each alternative over 15 years.

Table 7 compares the current staff plan with the proposed staff needed under each alternative. Projects required to carry out the final CCP would be funded through two separate systems, as follows: (1) the refuge operations needs system is used to document requests to Congress for money and staff needed to carry out projects above the existing base budget; and (2) the Service asset maintenance management system is used to document the equipment, buildings, and other existing properties that require repair or replacement.

Table 6. Costs over 15 years to carry out the CCP alternatives.

Refuge complex budget ($)	*Alternative A*	*Alternative B*	*Alternative C*	*Alternative D*
Budget Fiscal Year 2013	1,394,228	2,155,295	2,221,949	2,482,076
Salary expenditures	1,099,298	1,724,236	1,777,560	1,985,661
+Non-salary expenditures	294,930 (21)	538,824 (25)	555,487 (25)	620,519 (25)
Fixed costs*	229,705 (78)	259,705 (48)	249,705 (45)	279,705 (45)
Discretionary**	65,225 (22)	279,119 (52)	305,782 (55)	340,814 (55)
*Fixed costs related to operating refuge complex				
Monte Vista and Alamosa canal charges	30,000	30,000	30,000	30,000
Fuel, electricity, propane	84,500	84,500	84,500	84,500
Phone, garbage, internet, office, septic	38,205	38,205	38,205	38,205
Pumping costs	77,000	107,000	97,000	127,000

+Non-salary expenditures-percentages next to non-salary expenditures denote percent of budget. Percentage next to fixed costs and discretionary costs denote percent of non-salary expenditures.

** Discretionary costs include: Building and vehicle maintenance and repair, field supplies, technicians, shop supplies, herbicides, travel, volunteers, research, inventory and monitoring, safety, personnel training and awards, computers, law enforcement overtime and law enforcement supplies, and janitorial services. Yearly cost of living adjustments and salary step increases are not included.

Breakdown of Costs ($) by Activity to Implement Over 15 Years

Management cost item by refuge	*Alternative A*	*Alternative B*	*Alternative C*	*Alternative D*
Habitat and Wildlife*				
Alamosa Refuge				
Riparian	15,000	45,000	45,000	45,000
Wetland	220,000	450,000	650,000	450,000
Upland	6,000	22,000	28,000	22,000
Monte Vista refuge				
Riparian	n/a	n/a	n/a	n/a

Table 6. Costs over 15 years to carry out the CCP alternatives.

Wetland	225,000	675,000	1,200,000	675,000
Upland	10,000	150,000	750,000	150,000
Baca Refuge				
Riparian	225,000	445,000	445,000	445,000
Wetland	75,000	160,000	675,000	160,000
Playa	30,000	42,000	35,000	42,000
Upland	10,000	225,000	250,000	150,000
Bison management	0	350,000	50,000	520,000
Research and Monitoring (All Refuges)				
Habitat management and wildlife	210,000	375,000	375,000	375,000
Climate change	10,000	150,000	150,000	150,000
Total Biological Program All	**1,036,000**	**3,089,000**	**4,650,000**	**3,184,000**

*Costs for habitat and wildlife management includes costs for contracting out some infrastructure purchase, repair, construction, and modification as well as equipment rental costs or purchase of materials for refuge staff to perform these activities in-house. Note that costs associated with water (pumping, horsepower charges, and ditch assessments) have been listed elsewhere.

Cost Analysis for Visitor Services				
Management cost item	*Alternative A*	*Alternative B*	*Alternative C*	*Alternative D*
Alamosa Refuge				
Hunting big game, blinds	0	20,000	10,000	10,000
Fishing	0	0	0	100,000
Wildlife Observation				
Rehab Environmental Education Center	20,000	20,000	20,000	20,000
Trail Improvements				
River Trail	10,000	40,000	20,000	60,000
Town to refuge	0	20,000	0	20,000
Bluff trail parking	10,000	10,000	10,000	10,000
South loop trail	0	10,000	0	30,000
Auto tour route extension	0	500,000	0	500,000
Signage improvements	30,000	50,000	30,000	75,000
Overlooks, boardwalks, blinds	0	75,000	0	125,000
Kiosks with accessible parking	60,000	215,000	60,000	215,000
Parking improvements	50,000	500,000	50,000	600,000
Total Wildlife Observation	180,000	1,440,000	190,000	1,655,000
Outreach	10,000	20,000	10,000	40,000
Environmental Education	0	10,000	10,000	30,000
Total Visitor Services Alamosa Refuge	**190,000**	**1,490,000**	**220,000**	**1,835,000**
Monte Vista Refuge				
Visitor Center and Offices	0	3,000,000	0	3,000,000
Hunting big game, blinds	10,000	10,000	10,000	10,000
Fishing	5,000	5,000	5,000	5,000
Wildlife Observation				
Crane pullouts, pave 8S, new 6S, accessibility	20,000	150,000	0	150,000
Meadowlark trail accessibility	10,000	10,000	10,000	10,000

Table 6. Costs over 15 years to carry out the CCP alternatives.

New trails, Town, Parker Pond, visitor center	0	50,000	0	100,000
Non-motorized road improvements	0	250,000	0	250,000
Signs, directional and interpretive	15,000	30,000	30,000	30,000
Parking improvements	0	250,000	50,000	250,000
Overlooks, boardwalks	0	250,000	100,000	250,000
Total Wildlife Observation	45,000	990,000	190,000	1,040,000
Outreach	0	20,000	20,000	40,000
Environmental Education	0	10,000	10,000	30,000
Total Visitor Services Monte Vista	**60,000**	**4,035,000**	**235,000**	**4,125,000**
Baca Refuge				
Visitor contact station and office	770,000	25,000	20,000	50,000
Hunting	0	110,000	70,000	130,000
Fishing	0	0	0	0
Wildlife Observation Activities				
Auto tour route development	0	1,220,000	0	2,020,000
Non-motorized trail development	0	52,000	0	67,000
Lunching area development	10,000	30,000	10,000	30,000
Parking area development	0	48,000	3,000	125,000
Signs, directional and interpretive	159,000	292,000	129,000	342,000
Wildlife viewing area development	15,000	45,000	15,000	45,000
Baca history interpretive	45,000	135,000	45,000	150,000
Total wildlife observation	229,000	1,820,000	202,000	2,780,000
Outreach	25,000	65,000	40,000	85,000
Environmental Education	5,000	10,000	10,000	30,000
Total Visitor Services Baca Refuge	**1,029,000**	**2,030,000**	**342,000**	**3,070,000**
Total Cost Analysis for All Activities and Programs within the Refuge Complex				
Management cost item	*Alternative A*	*Alternative B*	*Alternative C*	*Alternative D*
Salaries, Fixed and Discretionary Costs	1,394,228	2,155,295	2,221,949	2,482,076
Total Biological Program	1,036,000	3,089,000	4,650,000	3,184,000
Cultural Resources Program	0	375,000	375,000	1,040,000
Total Visitor Services All	**1,279,000**	**7,560,000**	**797,000**	**9,040,000**
Grand Total All Activities ($)	**3,709,228**	**13,179,295**	**8,043,949**	**15,746,076**

Table 7. Personnel to carry out the CCP alternatives.

Alternative A (current staff)	*Alternative B*	*Alternative C*	*Alternative D*
Headquarters (Alamosa, Colorado)			
Project leader GS-0485–14	Project leader GS-0485–14	Project leader GS-0485–14	Project leader GS-0485–14
Deputy project leader GS–0485-13	Deputy project leader GS–0485-13	Deputy project leader GS–0485-13	Deputy project leader GS–0485-13
Wildlife biologist GS–0485-12	Wildlife biologist GS–0485-12	Wildlife biologist GS–0485-12	Wildlife biologist GS–0485-12
Land Management LE Officer GS-025-7/9	Land Management LE Officer GS-025-7/9	Land Management LE Officer GS-025-7/9	Land Management LE Officer GS-025-7/9
None	None	None	Land Management LE Officer GS 7/9
None	Supervisory Range Technician (interagency fuels planner) GS-455-9	Supervisory Range Technician (interagency fuels planner) GS-455-9	Supervisory Range Technician (interagency fuels planner) GS-455-9
½ FTE Interagency Supervisory Range Technician (Fire) GS-455-7 (career seasonal)	Convert to 1 FTE Interagency Supervisory Range Technician (Fire) GS-455-7/9	Convert to 1 FTE Interagency Supervisory Range Technician (Fire) GS-455-7/9	Convert to 1 FTE Interagency Supervisory Range Technician (Fire) GS-455-7/9
Budget Analyst GS-560-9 (Business Team)	Budget Analyst GS-560-9 (Business Team)	Budget Analyst GS-560-9 (Business Team)	Budget Analyst GS-560-9 (Business Team)
None (now a term position-see below)	Office Support Assistant GS-0303-4 (1) (converted from term position to full-time)	Office Support Assistant GS-0303-4 (1) (converted from term position to full-time)	Office Support Assistant GS-0303-4 (1) (converted from term position to full-time)
None	Wildlife biologist GS–0486-7/9	Wildlife biologist GS–0486-7/9	Wildlife biologist GS–0486-7/9
None	Biological Technician GS-404-5 (moved from Alamosa)	Biological Technician GS-404-5 (moved from Alamosa)	Biological Technician GS-404-5 (moved from Alamosa)
None	Outdoor Recreation Planner GS-0023-9 (1)	Outdoor Recreation Planner GS-0023-9 (1)	Outdoor Recreation Planner GS-0023-9 (2)
None	None	None	Environmental Education Specialist GS-9 (1)
None	None	Engineering Equipment Operator WG-9	None
None	Hydrologist GS-1315-9/11	Hydrologist GS-1315-9/11	Hydrologist GS-1315-9/11
None	None	None	Maintenance Worker (WG-8) (3)
Alamosa and Monte Vista National Wildlife Refuges			
Refuge manager GS–0485-12	Refuge manager Alamosa GS–0485-12	Refuge manager Alamosa GS–0485-12	Refuge manager Alamosa GS–0485-12
None	Refuge Manager Monte Vista GS-485-12	Refuge Manager Monte Vista GS-485-12	Refuge Manager Monte Vista GS-485-12
Biological Technician GS-0404-05 GS-0404	Position moved to HeadquartersGS-0404-05	Position moved to Headquarters	Position moved to Headquarters

Table 7. Personnel to carry out the CCP alternatives.

Alternative A (current staff)	*Alternative B*	*Alternative C*	*Alternative D*
None	Biological Technician GS-0404-0455-5	Biological Technician GS-0404-0455-5	Biological Technician GS-0404-0455-5
Maintenance Mechanic WG-4749-9 (Monte Vista)	Maintenance Mechanic WG-4749-9 (Monte Vista)	Maintenance Mechanic WG-4749-9 (Monte Vista)	Maintenance Mechanic WG-4749-9 (Monte Vista)
Maintenance Worker WG-4749-8 (Alamosa)	Maintenance Worker WG-4749-8 (Alamosa)	Maintenance Worker WG-4749-8 (Alamosa)	Maintenance Worker WG-4749-8 (Alamosa)
None	Tractor Operator (WG-6) (½ FTE-career seasonal)	Tractor Operator (WG-6) (½ FTE-career seasonal)	Tractor Operator (WG-6) (½ FTE-career seasonal)
None	Tractor Operator (WG-6) (½ FTE-career seasonal)	Tractor Operator (WG-6) (½ FTE-career seasonal)	Tractor Operator (WG-6) (½ FTE-career seasonal)
Baca National Wildlife Refuge			
Wildlife Refuge Manager GS–0485-12	Wildlife Refuge Manager GS–0485-12	Wildlife Refuge Manager GS–0485-12	Wildlife Refuge Manager GS–0485-12
Wildlife Refuge Specialist GS–0485-09	Wildlife Refuge Specialist GS–0485-09	Wildlife Refuge Specialist GS–0485-09	Wildlife Refuge Specialist GS–0485-09
Maintenance Worker WG-4749-8	Maintenance Worker WG-4749-8	Maintenance Worker WG-4749-8	Maintenance Worker WG-4749-8
None	Office Support Assistant GS-0303-4	Office Support Assistant GS-0303-4	Office Support Assistant GS-0303-4
None	None	None	Biological and Range Technician GS-0404/0455-7 (Bison) 0455-5
None	Tractor Operator (WG-6) (½ FTE-career seasonal)	Tractor Operator (WG-6) (½ FTE-career seasonal)	Tractor Operator (WG-6) (½ FTE career seasonal)
Seasonal Employees			
None	Range Technician GS-0455-5 (fire) (1)	Range Technician GS-0455-5 (fire) (1)	Range Technician GS-0455-5 (fire) (1)
None	Biological Technician GS-404-5 Biology program (6)	Biological Technician GS-404-5 Biology program (6)	Biological Technician GS-404-5 Biology program (6)
None	Biological Technician GS-404-5 weeds (3)	Biological Technician GS-404-5 weeds (3)	Biological Technician GS-404-5 weeds (3)
None	Social Services Assistant GS-0185-5 (1)	Social Services Assistant GS-0185-5 (1)	Social Services Assistant GS-0185-5 (1)
Office Support Assistant (Term) GS-0303-4 (½) FTE	None (position converted to full time at headquarters)	None (position converted to full time at headquarters)	None (position converted to full time at headquarters)
None	None	None	Park Ranger GS-025-5 (3)

* GS=General Schedule employee by pay grade; WG=Wage Grade employee by pay grade.

** Depends on Interpretive Contact Station being built at Monte Vista Refuge.

Table 8 is a summarized, side-by-side look at the actions for each alternative. An analysis of these actions is in “Chapter 4—Environmental Consequences”; a summary of the expected consequences of the alternatives is in table 36 at the end of chapter 5.

Table 8. Summary of alternatives actions for San Luis Valley Refuge Complex CCP and EIS.

Alternative A No-Action	*Alternative B Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Proposed Action)*	*Alternative C Habitat Restoration and Ecological Processes*	*Alternative D Maximize Public Use Opportunities*
Habitat and Wildlife Goal: Conserve, restore and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.			
Water Resources Goal: As climate patterns change, protect, acquire and manage surface and ground water resources to maintain and support management objectives.			
Visitor Services Goal: Provide safe, accessible and quality wildlife-dependent recreation and perform outreach to visitors and local communities to nurture an appreciation and understanding of the unique natural and cultural resources of the refuge complex and San Luis Valley.			
Partnerships and Refuge Operations Goal: Secure and effectively use funding, staffing, and partnerships for the benefit of all resources in support of the refuge complex purposes and the mission of the Refuge System. Actively pursue and continue to foster partnerships with other agencies, organizations, the water community and private landowners to conserve, manage, and provide long-term sustainability of the working landscapes within the San Luis Valley ecosystem.			
Cultural Resources Goal: Protect significant cultural resources within the San Luis Valley National Wildlife Refuge Complex.			
Research, Science and Wilderness Review Goal: Use sound science, applied research, monitoring, and evaluation to advance the understanding of natural resource functions, changing climate conditions, and management of the habitats within the San Luis Valley ecosystem.			
HABITAT AND WILDLIFE MANAGEMENT			
Habitat Type: Riparian (Rio Grande and Large and Small Creeks) (Alamosa and Baca)			
On the Alamosa Refuge: Manage and enhance Rio Grande corridor where possible, providing habitat for river and riparian-dependent species (southwestern willow flycatcher and other obligates). **On the Baca Refuge:** Evaluate condition and identify areas of degradation and invasive species. Take steps to address obvious problems within existing resource levels.	**On the Alamosa Refuge:** Maintain or enhance a minimum of 50 acres of existing willow and cottonwood riparian habitat along Rio Grande. On off-channel sites, restore about 50 acres of moderate to dense (>35 percent canopy cover) willow and cottonwood riparian cover. **On the Baca Refuge:** Maintain existing reaches of healthy riparian habitat (dense and multilayered) with diverse woody vegetation species. Restore about 21 miles along 4 creek drainages that are in poor condition (scattered plants, <2 feet tall). Achieve a >35 percent canopy cover of 15-30 feet wide.	Same as alternative B	Same as alternative B plus **On the Baca Refuge:** Locate bison pastures near public access points. Use conservative stocking rates and use frequent rotation. Keep bison out of riparian areas.

Table 8. Summary of alternatives actions for San Luis Valley Refuge Complex CCP and EIS.

Alternative A No-Action	*Alternative B Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Proposed Action)*	*Alternative C Habitat Restoration and Ecological Processes*	*Alternative D Maximize Public Use Opportunities*
	Maintain hydrologic conditions in the creek channels. Reduce browsing pressure using fencing, dispersal, hazing, culling, and hunting. Use plantings or seed as needed. Ensure any use of other management tools (i.e. grazing, fire, and mowing) do not negatively impact riparian areas.		
Habitat Type: All Wetland types (All Refuges)			
Alamosa and Monte Vista Refuges: Continue to manage existing wetland areas and wetland conditions (short-emergent, tall emergent, open water) with an emphasis on waterbird production. Maximize wetland conditions, irrigating from spring through fall (depending on water availability) for many different species. Shallowly flood the various wetland types ranging between 20-50 percent of the acreage to meet the needs of various species. Use variety of management tools—prescribed burning, grazing, and weed control. **Baca Refuge:** Through irrigation, continue to maintain and monitor overall graminoid health of the wet meadows. Where obvious degradation is occurring (i.e. invasive species), take corrective action. Continue to collect baseline information.	**Alamosa and Monte Vista Refuges:** Similar to A in providing for a variety of wetland conditions, but with a greater focus on meeting the needs of the wetland focal bird species listed in table 3 which should in turn represent other wetland obligate species. Where practical restore historical water flow patterns through more efficient water management, allowing some areas to revert to uplands while making sure water gets to the most productive wetland areas. **Baca Refuge:** Similar to alternative A, but focus on applying irrigation more effectively and efficiently on at least 10-20 percent of irrigable acreage where short emergent wetlands occurred historically. Use grazing, haying, mowing, and weed control.	**Alamosa and Monte Vista Refuges:** To the extent practical, over time, restore historical water flow patterns allowing many wetland areas to revert to uplands. For example on the Monte Vista Refuge, water application during early spring migration would be restricted to the Spring Creek and Rock drainages (main channels). During nesting season this would also include Cat Creek. On the Alamosa Refuge, water would be restricted to the deepest natural flow slough and oxbows formed by the Rio Grande. **Baca Refuge:** Confine irrigable water to natural channels, oxbows, slough and depression. Shallowly inundate on the low areas beyond diversions. Modify infrastructure that alter water flows that limit restoration.	**Alamosa and Monte Vista Refuges:** Similar to alternative A. **Baca Refuge:** Similar to alternative B.

Table 8. Summary of alternatives actions for San Luis Valley Refuge Complex CCP and EIS.

Alternative A No-Action	*Alternative B Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Proposed Action)*	*Alternative C Habitat Restoration and Ecological Processes*	*Alternative D Maximize Public Use Opportunities*
	Habitat Type: Playas (Baca Refuge Only)		
After wet meadows are irrigated, allow excess water to enter playa habitat generally midway or late into the breeding season allowing for some foraging opportunities for a variety of shorebirds.	Adaptively rotate delivery of water from three different input points a minimum of one out of three years to provide playa habitat during spring migration when possible and summer nesting periods when possible.	Direct through decreed diversion points, at least 90 percent of available water in each creek drainage into the lowest (elevation) flow path available to allow water to reach playa habitats to provide for spring migration and summer nesting especially for shorebirds and teal. Primary difference from alternative B is that water would be annually directed from all of the creek systems resulting in more reliable playa habitat for shorebirds.	Same as alternative D
	Habitat Type: Uplands (All Refuges)		
Alamosa and Monte Vista Refuges: Continue to provide native shrub (primarily greasewood and rabbitbrush on the Monte Vista Refuge and saltbush on the Alamosa Refuge. Treat invasive species where possible. **Baca Refuge:** Continue to monitor health of shrublands, taking corrective action where obvious degradation is occurring.	**Alamosa and Monte Vista Refuges:** Restore a minimum of 50 acres of former farmland on the Monte Vista Refuge and 100 acres on the Alamosa Refuge. Focus on maintaining habitat heterogeneity (various seral stages) of all shrub habitat. Apply natural disturbance regimes (fire, grazing, hydrology) and treat invasive species to benefit upland focal bird species (table 4). **Baca Refuge:** Maintain habitat heterogeneity of all shrub habitats, similar to other refuges above, with focus on benefiting upland focal bird species.	**Alamosa and Monte Vista Refuges:** Within 4-5 years, on the Monte Vista Refuge initiate restoration on a minimum of 1,000 acres and 800 acres on the Alamosa Refuge that were formerly converted to wetlands by reducing depth and duration of flooding. By year 15, achieve 20-30 percent shrub cover and limit invasive species to 10-15 percent of these areas. Plant native seeds use native shrubs on retired farmlands. **Baca Refuge:** Similar to alternative B	**Alamosa and Monte Vista Refuges:** Same as alternative A. **Baca Refuge:** Similar to alternative A

Table 8. Summary of alternatives actions for San Luis Valley Refuge Complex CCP and EIS.

Alternative A No-Action	*Alternative B Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Proposed Action)*	*Alternative C Habitat Restoration and Ecological Processes*	*Alternative D Maximize Public Use Opportunities*
Shrub–grass on the Baca Refuge. Similar to upland shrubs alternative A above.	Initially, create and maintain a greater heterogeneity of this habitat type by altering plan community structure and composition on +/- 5 to 10 percent of 14,473 acres of this habitat type on annual basis using variety of management tools and achieving natural disturbance regimes in order to benefit upland obligate focal birds (table 4). By year 15, increase acreage if appropriate.	Convert 4-60 percent of habitat type (600-900 acres) to sandsheet rabbitbrush through reduced flood irrigation practices.	Same as alternative B.
WILDFIRE MANAGEMENT (ALL REFUGES)			
Suppress refuge complex wildfires using most effective methods. Continue to participate in interagency fire management team. Identify funding sources to reduce fuel hazards to adjoining property.	Same as alternative A plus: follow all wildland and urban interface guidelines in order to minimize impact to private property and human life from refuge wildfires. Minimize construction of new facilities that could increase problems along wildland and urban interface. Maintain fire breaks on refuge lands. Conduct additional research and literature review to better understand implications of fire as a result of climate change, land-use development and other factors. Increase involvement with interagency partners including rural volunteer fire departments.	Same as alternative B.	Same as alternative B.
Wildlife Management Threatened and Endangered Species (Southwestern Willow Flycatcher-Alamosa Refuge)			
Contribute to recovery goals for southwestern willow flycatcher.	Maintain and enhance a minimum of 50 acres of existing suitable habitat and initiate efforts to restore +50 acres of additional suitable habitat at locations off the main channel of the Rio Grande.	Same as alternative B	Same as alternative B

Table 8. Summary of alternatives actions for San Luis Valley Refuge Complex CCP and EIS.

Alternative A No-Action	*Alternative B Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Proposed Action)*	*Alternative C Habitat Restoration and Ecological Processes*	*Alternative D Maximize Public Use Opportunities*
Wildlife Management Sandhill Cranes (Monte Vista Refuge Only)			
Continue to support sandhill cranes by producing agricultural grains for spring and fall migrant waterfowl and 15 percent of the fall and 85 percent of the spring sandhill crane population on the Monte Vista Refuge.	Similar to alternative A. Produce a minimum of 190 acres of small grains (primarily barley). Provide adequate roost habitat by shallowly flooding traditional crane roost areas in Units 14, 19, and 20.	Eliminate grain production.	Similar to alternative B except produce a minimum of 230 acres to provide food and energy resources for spring migrating sandhill cranes to maximize viewing opportunities.
Wildlife Management – Focal Bird Species (All Refuges)			
Continue to manage for a variety of migratory bird species.	Manage refuge habitats to create the hydrologic and vegetative conditions (species diversity, density, and structural conditions) necessary to provide the lifecycle requirements of focal birds (table 3 riparian birds; table 4 wetlands; table 5 uplands) identified for the refuge complex.	Similar to alternative B	Similar to alternative B
Wildlife Management – Bison Baca Refuge Only			
By 2016 phase out the existing arrangement allowing TNC to graze on the Baca Refuge lands which were formerly part of TNC's Medano Ranch (6,200 acres)	Same as alternative A plus: utilize bison along with other livestock (cattle and sheep) as a prescribed tool to meet the habitat objectives on the Baca Refuge.	Same as alternative A plus: utilize bison along with other livestock (cattle and sheep) as a prescribed tool to meet the habitat objectives on the refuge.	Small bison demonstration herd (≤25)
	Research feasibility of allowing some semi-free ranging bison on a year round basis, in a designated area on the Baca Refuge. Purpose would be to see if the refuge could support future use or occurrence of bison on the refuge.		
Wildlife Management – Rocky Mountain Elk (All Refuges)			
Continue to conduct population surveys to monitor the density and distribution of the elk population on the refuges. Work with CPW in efforts to reduce and redistribute population as necessary. Implement actions interim elk management plan.	Implement a hunt plan to reduce and redistribute the elk population, reduce the browsing pressure on riparian areas, and provide the public with big game hunting opportunities on the refuge. Establish and implement a chronic wasting disease monitoring plan.	Similar to alternative B except: reduce and redistribute elk population to meet the CPW's goal for GMU 82. Work with the State in culling or dispersal of elk population.	Similar to alternative B.

Table 8. Summary of alternatives actions for San Luis Valley Refuge Complex CCP and EIS.

Alternative A No-Action	*Alternative B Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Proposed Action)*	*Alternative C Habitat Restoration and Ecological Processes*	*Alternative D Maximize Public Use Opportunities*
Wildlife Management –Rio Grande Sucker and Rio Grande Chub (Baca Refuge Only)			
Continue to monitor and evaluate condition of Rio Grande sucker and Rio Grande chub habitat.	Same as alternative A plus conduct research to determine effects of refuge management on populations.	Similar to alternative B except we would restore natural flow paths on the Baca Refuge.	Similar to alternative B
WATER RESOURCES MANAGEMENT			
Water Management – All Refuges			
Maintain all water rights enabling maximum use of ground and surface water for maintenance of wildlife habitat. On the Monte Vista Refuge use the most water efficient methods of irrigating grain crops.	Same as alternative A plus establish a repeatable and quantitative water quality monitoring program on all refuges to identify contaminants, toxins and other contributors to pool soil and water quality. Complete area and capacity surveys of the most important wetlands to better understand how to maintain productivity. Manage ground water and surface water together to achieve refuge objectives. On the Baca Refuge, restore facilities that were historically used to irrigate the playa wetlands. Evaluate potential of Monte Vista Refuge as a site for confine and unconfined aquifer storage recharge.	Same as alternative B except irrigation of croplands would be eliminated.	Same as alternative B plus prioritize water management to improve visitor experiences to enhance wildlife viewing. Collaborate with schools, Friends group, or volunteers to assist with collecting water quality and quantity data.

Table 8. Summary of alternatives actions for San Luis Valley Refuge Complex CCP and EIS.

Alternative A No-Action	*Alternative B Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Proposed Action)*	*Alternative C Habitat Restoration and Ecological Processes*	*Alternative D Maximize Public Use Opportunities*
VISITOR SERVICES			
Visitor Services – Hunting (All Refuges)			
Alamosa and Monte Vista Refuges: Continue to provide waterfowl and limited small game hunting within designated hunt boundaries. **Baca Refuge:** No public hunting.	**All Refuges:** By year 3, develop a refuge complex hunting plan that is 50 percent implemented by year 4 and 100 percent implemented by year 7. Work with partners to create diverse, quality hunting opportunities. By year 8, 60-70 percent of hunters report satisfaction with hunting experience. By year 8, work with CPW to develop one new hunt for youths. By year 5, provide better parking, blinds, and other facilities that are more accessible. By year 10, add additional accessible hunting access area at Alamosa. **Alamosa and Monte Vista Refuges:** Same as alternative A plus: develop restricted big game hunt (agency culling would also occur). **Baca Refuge:** By year 3, open small game hunting along southwest boundary and allow permitted archery north of Crestone Creek. By year 7, open other portions of refuge to big game hunting and expand small game hunting.	**All Refuges:** By year 5, develop a refuge complex hunting plan that is 50 percent implementable by year10 and 100 percent by year 15. Work with partners to create diverse, quality hunting opportunities. **Alamosa and Monte Vista Refuges:** Same as alternative B **Baca Refuge:** By year 5, open small game hunting along southwest boundary and allow permitted archery north of Crestone Creek. By year 10, open other portions of refuge to big game hunting and expand small game hunting.	**All Refuges:** Similar to alternative B except: Within 10 years, 70-80 percent of hunters report being satisfied with experience. Within 4 years, work with CPW to establish two youth hunts. Within 4 years, improve accessible facilities, and if needed provide two new accessible facilities, one at Alamosa and one at Monte Vista. Allow for game retrieval with ATVs. **Alamosa and Monte Vista Refuges:** Same as alternative B **Baca Refuge:** Similar to alternative B except efforts would be made to encourage additional opportunities for youths and hunters with mobility impairments. A larger number of licensed hunters could be allowed over B.
Visitor Services – Fishing (Monte Vista and Alamosa Refuges)			
Maintain youth fishing event at Monte Vista Refuge.	Same as alternative A	Same as alternative A	Same as alternative A plus permit walk-in fishing access along the Rio Grande on the Alamosa Refuge south of parking area 5. Develop safe access point and pier at Chicago dam.

Table 8. Summary of alternatives actions for San Luis Valley Refuge Complex CCP and EIS.

Alternative A No-Action	*Alternative B Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Proposed Action)*	*Alternative C Habitat Restoration and Ecological Processes*	*Alternative D Maximize Public Use Opportunities*
Visitor Services – Wildlife Observation, Photography, and Interpretation (All Refuges)			
Alamosa and Monte Vista Refuges: Maintain or upgrade existing wildlife facilities and programs at Alamosa and Monte Vista refuges. **Baca Refuge:** Develop primitive observation facilities at Baca Refuge (a few signs or kiosks along boundary or at refuge office).	**All Refuges:** Within 5 years, develop a visitor services plan that identifies specific programming elements, interpretive themes, messages, and audiences. Hire staff to support program. **Alamosa and Monte Vista Refuges:** Increase participation and enhance opportunities by improving facilities and programs. Increase annual visit by 15-25 percent with +75 percent visitors reporting satisfaction with visit. Seasonally (July 15-February 28) open trails or roads within hunt boundary for biking and walking. Work with partners to develop trail links to Alamosa and Monte Vista refuges. Within 3-7 years, extend auto tour route east on the Alamosa Refuge to connect to the Bluff Road. Extend and improve Rio Grande and Meadowlark nature trails. Build visitor center at Monte Vista Refuge. Repurpose contact station at Alamosa to focus on environmental education. **Baca Refuge:** Within 2 years, open portions of refuge for public use including walking, biking, and limited horse access. By year 15, fully develop access including auto tour route, trails, facilities, and other programs. Adaptively reuse cattle headquarters building. Work with NPS to interpret Trujillo homestead.	**Alamosa and Monte Vista Refuges:** Same as alternative A except open trails and roads in hunting area from July 15-February 28 for biking and walking. Upgrade existing facilities and trails. **Baca Refuge:** Similar to alternative A with limited public access.	**Alamosa and Monte Vista Refuges:** Expanded over alternative B to include: Increase participation by 25-40 percent through additional access, improved facilities and programs and additional staff including more opportunities for year around access. Add additional viewing and observation areas. Staff the current visitor center at Alamosa 4-5 days per week. Build and design a new visitor center at Monte Vista Refuge **Baca Refuge:** Similar to alternative B plus: extend the auto tour route south (seasonal basis). Work with others to establish a multi-agency visitor contact station. Hire additional staff to support programs.

Table 8. Summary of alternatives actions for San Luis Valley Refuge Complex CCP and EIS.

Alternative A *No-Action*	*Alternative B* *Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses* *(Proposed Action)*	*Alternative C* *Habitat Restoration and Ecological Processes*	*Alternative D* *Maximize Public Use Opportunities*
Visitor Services – Environmental Education (All Refuges)			
Alamosa and Monte Vista Refuges: Maintain limited educational programs including Monte Vista Crane Festival and Kid's Fishing Day. **Baca Refuge:** No environmental education programs.	**All Refuges:** By year 5-10, improve existing programs on and off refuges including developing educator's guide, curriculum-based programming. Provide minimum of two school or teacher trainings per year. Modify existing curricula tailored to refuge complex including topics like hydrology, climate change, and others. **Alamosa and Monte Vista Refuges:** By year 5, retrofit existing building at Alamosa to be accessible and establish a discovery station geared toward school groups and young visitors. **Baca Refuge:** By year 5-8, host a minimum of 6 programs and activities annually.	**Alamosa and Monte Vista Refuges:** Same as alternative A. **Baca Refuge:** Very limited. Would offer 10 guided tours or programs	**All Refuges:** Same as alternative B plus: Expand number of programs to 20 school visits per year. Work with partners to establish San Luis Valley auto tour route **Alamosa and Monte Vista Refuges:** Similar to alternative B. **Baca Refuge:** Convert barn to environmental education center. Use it for youth programs, camps, classroom space, and exhibits.
Visitor Services – Outreach (All Refuges)			
All Refuges: Maintain current outreach levels including: public presentations, news releases, weed tours, county commissioner meetings, and other briefings for agencies and organizations. Recruit volunteers to support staff. Seek grants to fund special events, and keep the public informed about refuge programs and activities through the Web site.	**All Refuges:** Same as alternative A plus: develop outreach plan as part of visitor services' plan above. Develop new brochures that highlight the refuge complex opportunities and interpretive themes. Develop specific brochures as needed. Update the refuge complex Web site. Host information-sharing events for media and other organizations.	**All Refuges:** Same as alternative B.	**All Refuges:** Similar to alternative B plus: place greater emphasis on outreach for both communicating wildlife and habitat goals and increasing visitation to the refuge. For example, by year 5, work with Friends group to develop electronic newsletter two times per year.
Visitor Services – Commercial Recreation (All Refuges)			
Continue to only allow limited commercial recreational use (i.e. photography) by special permit.	Same as alternative A plus: plus allow for additional limited commercial recreation (such as equestrian outfitter, nature trail rides at Baca Refuge, and photography).	Same as alternative A.	Same as alternative B.

Table 8. Summary of alternatives actions for San Luis Valley Refuge Complex CCP and EIS.

Alternative A No-Action	*Alternative B Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Proposed Action)*	*Alternative C Habitat Restoration and Ecological Processes*	*Alternative D Maximize Public Use Opportunities*
PARTNERSHIPS AND REFUGE OPERATIONS			
Partnerships (All Refuges)			
Maintain existing partnerships including Federal, State, and local agencies, tribes, and organizations. Continue working within the Partners for Fish and Wildlife program to support privately-owned habitats critical to the refuge complex.	Same as alternative A plus: establish new partnerships (such as local universities or other organizations) that can help us achieve our goals and objectives. For example, work with NPS to interpret and assist us with managing the Pedro Trujillo homestead on the Baca Refuge.	Same as alternative A plus: pursue additional partnerships to support the restoration program.	Same as alternative A and B plus: work with other organizations that help us facilitate better wildlife-dependent recreational opportunities. Work with others to incorporate the refuge complex into Sangre de Cristo National Heritage Area programming.
Refuge Operations (All Refuges)			
All Refuges: Maintain refuge personnel at current staffing levels as identified in table 7. Maintain existing auto tour routes, trails, and facilities, on the Alamosa and Monte Vista refuges	**All Refuges:** Same as alternative A plus: Justify and obtain the following new positions: convert 1 office support assistant from term to full-time for refuge headquarters; add 1 office support assistant for Baca Refuge; add 1 outdoor recreation planner for the refuge complex; add 1 hydrologist for the refuge complex; add 1 wildlife biologist for refuge complex; change 1 biological technician from Alamosa to refuge headquarters; add 1 biological technician for the refuge headquarters; add 1 refuge manager for Monte Vista Refuge; add 1 supervisory range technician for interagency fuel planning (GS-9); convert existing ½ FTE for interagency fire technician to full-time (GS-7); add 1 FTE (two seasonal ½ FTEs) tractor operators for refuge headquarters and add ½ FTE tractor operator for Baca Refuge ; and additional seasonal positions.	**All Refuges:** Similar to alternative B but positions might vary some to support habitat restoration efforts. For example, we would add an engineering equipment operator.	**All Refuges:** Same as alternative B plus: add an additional outdoor recreation planner and an environmental education specialist, a law-enforcement officer, three additional maintenance workers and seasonal positions for public use.

Table 8. Summary of alternatives actions for San Luis Valley Refuge Complex CCP and EIS.

Alternative A No-Action	*Alternative B Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Proposed Action)*	*Alternative C Habitat Restoration and Ecological Processes*	*Alternative D Maximize Public Use Opportunities*
	Alamosa and Monte Vista Refuges: Build a visitor center at Monte Vista Refuge. On the Alamosa extend tour route out to Bluff road. Open additional nature trails (or extensions) at Alamosa and Monte Vista refuges and make other improvements for visitor services (trails, viewing blinds or observation facilities).Replace the Lillpop office on the Alamosa with small bunkhouse and vehicle sites for volunteers. Improve accessibility of current facilities. **Baca Refuge:** Initiate cleanup of the ranch headquarters area. By year evelop visitor and hunter access.	**Alamosa and Monte Vista Refuges:** Similar to alternative A plus: better facility support for existing facilities. **Baca Refuge:** Limited facilities. Some hunter access would need to be provided.	**Alamosa and Monte Vista Refuges:** Same as alternative B plus: build additional facilities to support visitor services (such as seasonal tour routes on both refuges, additional wildlife observation facilities, improved access). **Baca Refuge:** Similar to alternative B plus: extend auto tour route to the south (seasonal access); develop additional viewing or other facilities. Work with NPS to provide trail link to Great Sand Dunes. Convert the barn to interpretive and environmental education facility.
CULTURAL RESOURCES MANAGEMENT			
Cultural Resources (All Refuges)			
All Refuges: Continue adherence to cultural resource laws. Offer occasional outreach like presentations or erect limited signage. Work with Friends group or others to accomplish preservation and research objectives. Maintain law enforcement monitoring of known sites and sensitive areas.	**All Refuges:** Same as alternative A plus: offer education outreach (such as presentations, signs, and brochures) about the importance of refuge complex history. Work with other partner groups to accomplish preservation and research objectives. Complete limited surveys in response to Section 110 of the National Historic Preservation Act. Establish erosion control measures on threatened sites. **Baca Refuge:** Fully record cow camps. Stabilize the house at Baca headquarters. See funding for restoration of demonstration buildings deemed appropriate for reuse.	**All Refuges:** Same as alternative A except: remove structures or buildings that are not needed for refuge operations and are intrusive to historic districts or landscapes.	**All Refuges:** Similar to alternative B plus: increase partnerships, outreach, and other activities to improve cultural resources program.

Table 8. Summary of alternatives actions for San Luis Valley Refuge Complex CCP and EIS.

Alternative A No-Action	*Alternative B Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Proposed Action)*	*Alternative C Habitat Restoration and Ecological Processes*	*Alternative D Maximize Public Use Opportunities*
RESEARCH, SCIENCE, AND WILDERNESS REVIEW			
Climate Change (All Refuges)			
Incorporate and follow Secretarial order 3289, and other executive orders and policies in all facets of refuge management and operations related to climate change.	Same as alternative A	Same as alternative A	Same as alternative A
Research, Science, and Monitoring (All Refuges)			
Conduct research and monitoring as opportunities arise and funding permits.	Same as alternative A plus: conduct research, inventory, and monitoring related to CCP implementation.	Same as alternative B	Same as alternative B
Wilderness Review (Baca Refuge)			
No wilderness study areas recommended	Manage the southeastern portion of the refuge totaling 13,800 acres as a wilderness study area. Within 5 years, complete inventory, finalize the review process, and forward final recommendations to the Director of the Service.	Same as alternative B	Same as alternative B

Chapter 4—Affected Environment

A wetland on Alamosa Refuge.

The affected environment section describes those parts of the natural and human environment that could be affected by carrying out any of the proposed management alternatives. This chapter describes the characteristics and resources of the Monte Vista, Alamosa, and Baca Refuges, how we manage the refuge complex, and the effects of current and past management and influences on resources. It specifically addresses the physical environment; biological environment; special land designations; wildlife-dependent recreational opportunities; cultural resources and tribal interests, including a history of human use on the site; and the socioeconomic environment. We used Service data, scientific studies, and communication with resource professionals, both published and unpublished, to describe the resources of the refuge complex.

4.1 Topics Not Analyzed Further

Canada lynx, black-footed ferret, wolverine, gray wolf, Gunnison's sage grouse, boreal toad, Rio Grande cutthroat trout, and Uncompahgre fritillary butterfly were dismissed from further consideration because the alternatives addressed in this document would have no effects on these species or any effects would be negligible. (Refer to table 13, section 4.3 below.)

4.2 Physical Environment

The following sections discuss the physical characteristics that could be affected by the implementation of the CCP. Physical characteristics that are covered are topography, climate, climate change, air quality, geology, minerals, soils, water resources, visual resources and night skies, and soundscapes.

Topography

The San Luis Valley is a large, high elevation basin which is more than 7,500 feet above mean sea level.

Implementation of the CCP would have no effect on topography.

Climate

The climate of the San Luis Valley is arid, with cold winters and moderate summers. Winds, which are usually from the south-southwest with speeds of 40 miles per hour, are common in spring and early summer. There is wide seasonal and annual variation in precipitation. In some years, snow cover can be sparse or totally lacking in the San Luis Valley (BLM 1991). The San Luis Valley lies in the rain shadow of the San Juan Mountains and receives about 7 inches of precipitation per year. Great Sand Dunes National Park and Preserve, on the southeast side of the Baca Refuge, receives an average of about 11 inches annually. About 60 percent of this precipitation occurs as rain in July and August. This summer moisture comes from the Gulf of Mexico and the Gulf of California and is a result of monsoonal flow that moves north through Arizona and New Mexico into the San Luis Valley (Heitmeyer and Aloia 2013a,b,c).

Long-term precipitation data from Saguache, Del Norte, and Manassa, Colorado, suggest that alternating low and high precipitation periods recur on roughly a 30-year cycle (figures 29, 30, and 31). Dry periods occurred in the 1890s, the 1930s, the early 1950s, the early 1970s, the late 1980s, and the middle of the first decade of this century (Thomas 1963, Striffler 2012, Heitmeyer and Aloia 2013a, b, c). Long-term trends in annual precipitation vary somewhat based on location in the San Luis Valley. The long-term annual precipitation trend for Saguache, Colorado, is generally stable, while trends at Crestone, Colorado show a gradual decline in precipitation (Striffler 2013). Recent studies have analyzed tree-ring data to reconstruct historical streamflow through the Rio Grande Basin (Correa 2007). These data suggest that the frequency and duration of droughts have increased over the last 730 years.

The mean annual temperature is 43 Fahrenheit (°F) at Del Norte, Colorado, and the temperature trend is increasing. Low temperatures of -20 to -30 °F can be expected each year, and average highs are in the 80s. The annual frost-free growing season averages between 90 and 100 days from late May to early September (Emery 1996); however, there is wide variation between years, and July and August

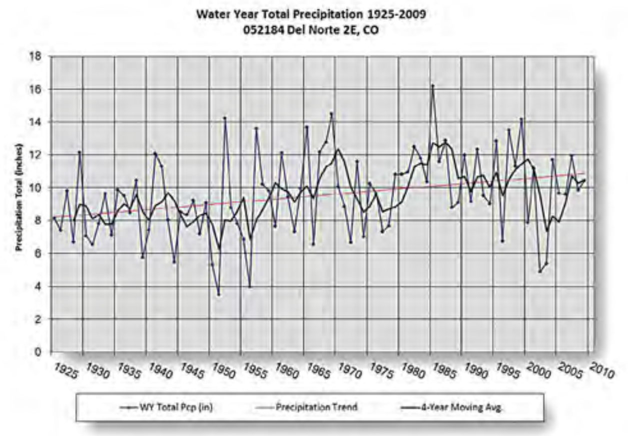

Figure 29. Total water precipitation (inches) for Del Norte, Colorado, 1925-2010.

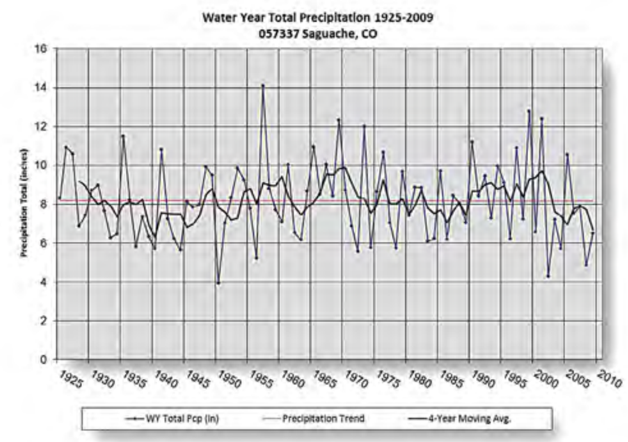

Figure 30. Total water precipitation (inches) for Saguache, Colorado, 1925-2009.

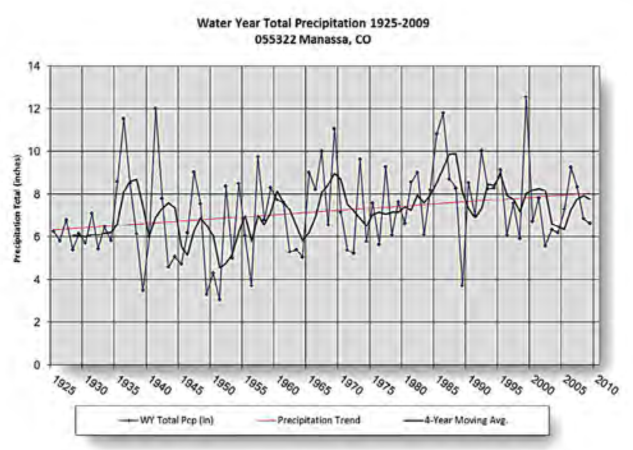

Figure 31. Total water precipitation (inches) for Manassa, Colorado, 1925-2009.

are typically the only frost-free months. Evapotranspiration, which is evaporation from the soil surface plus water use by plants, is typically 45 to 50 inches per year (Leonard and Watts 1989, Ellis et al. 1993). A precipitation deficit (potential evapotranspiration minus precipitation) occurs every month of the year, and deficits are largest in June (Leonard and Watts 1989, Ellis et al. 1993).

The increasing temperature trend is expected to raise average soil temperatures and increase the evapotranspiration rate. The increasing temperature effect outweighs the increasing precipitation trend (BOR 2013b; Striffler 2013, Heitmeyer and Aloia 2013 a, b, c), thereby increasing the precipitation deficit and reducing water resources available throughout the San Luis Valley.

Climate Change

In 2009, the U.S. Global Change Research Program released a comprehensive report (Karl et al. 2009) that synthesized information from a wide variety of scientific assessments and described what is known about the observed and projected consequences of climate change. Average temperatures in the United States have increased by more than 2 °F over the past 50 years. More locally, a report for the Colorado Water Conservation Board shows that temperatures in Colorado increased by about 2 °F between 1977 and 2006 (Ray et al. 2008).

Recently, BOR (2013b) issued a west-wide climate risk assessment that covers the upper Rio Grande, including the San Luis Valley and the San Juan and Sangre de Cristo Mountains. For the entire upper Rio Grande study area, temperatures increased substantially from 1971 through 2012, with average annual temperatures increasing by 2.5 °F. Nighttime low temperatures increased faster than daytime high temperatures (2.7 °F vs. 1.8 °F). Mountain and valley regions responded differently to warming, with average temperatures in the mountains increasing by 2.7 °F, but average temperatures in the valleys increasing by only 1.6 °F over the same period (BOR 2013b).

Overall, climate change is projected to significantly decrease available water supplies in the Upper Rio Grande Basin. Supplies from all native water sources to the Rio Grande are projected to decrease by about one-third. Most flow decreases would occur between June and September, and peak flows, which are now in June, are predicted to shift to May (BOR 2013b).

In all parts of Colorado, no consistent long-term trends in annual precipitation have been detected. Variability between winters is high, which makes detection of trends difficult. Between 1978 and 2004, some data suggest the spring pulse (onset of streamflows from melting snow) in Colorado has shifted earlier by two weeks (Ray et al. 2008), while other reports suggest it is three weeks earlier (Painter et al. 2010). Several studies suggest that shifts in timing and volume of streamflows are related to warming spring temperatures. There are concerns about declines in the spring snowpack because of decreased snow cover on the lower slopes of high mountains, recurring high winds in spring, and ensuing dust events caused in part by increased human activities in the deserts of the southwest (USGS 2010). Other factors include prolonged drought patterns; overall-location of water resources; and increased potential for severe wildfires, invasive species, and other changes.

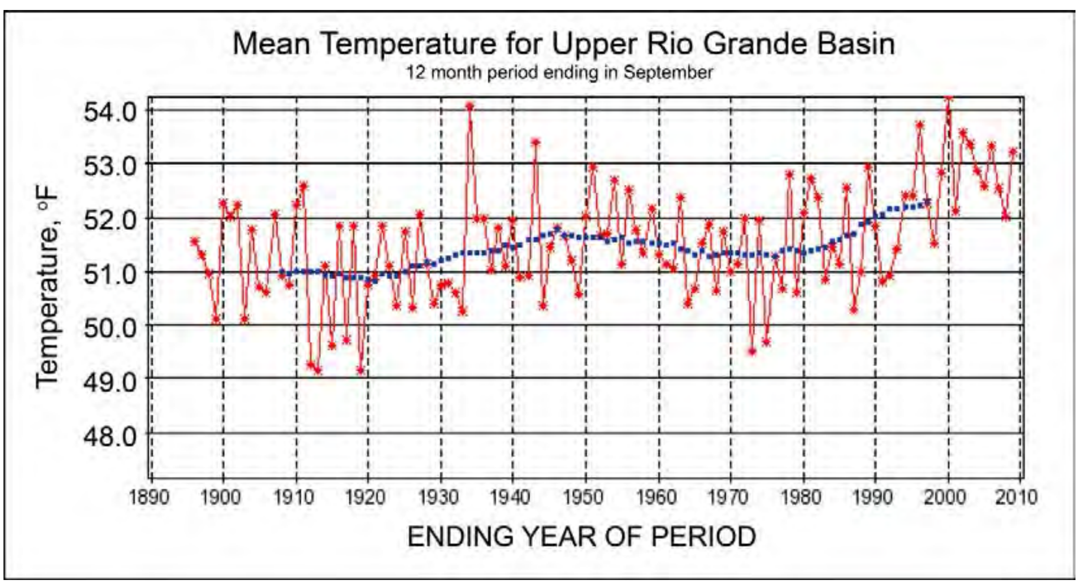

Figure 32. Mean temperature for Upper Rio Grande Basin from the 1890s to 2010.
Source: BOR 2013b

It is difficult to assess how climate change will affect the biological and social resources in the refuge complex because of ongoing drought conditions, overallocation of water resources in the San Luis Valley, uncertainty about the administration of new State water regulations (see Water Resources below), and limited operational funding to manage the refuges. BOR (2013b) found that potential adaptation and mitigation strategies for the hydrologic response to climate change need to be evaluated in future studies. This will require an analysis of the key thresholds (ecological resilience) associated with both social and ecological systems in the basin. Adaptation could involve transitions into new thresholds for social and ecological systems, rather than simply building resilience into the old social and ecological states (BOR 2013b).

We have been proactively applying the Service's climate change strategy (adaptation, mitigation, and engagement) in the San Luis Valley through landscape conservation planning and strategic habitat conservation (chapter 1, section 1.3), as well as by responding to changes in State water regulations, which affect all users in the San Luis Valley (see Water Resources below).

Air Quality

Air quality in the San Luis Valley is generally good. Except for ozone, existing air pollutant concentrations in the vicinity of the refuge complex are relatively low because there are few air pollution sources in the region. There are limited industrial facilities, and residential emissions are primarily from smaller communities and isolated ranches. Some local, naturally generated particulate matter occurs as windblown dust, in part because of the dry climate. In 2012, air quality data from the EPA (2012b) said that Alamosa County, which is the most populous county in the area, had 332 days of good air quality, 27 days of moderate air quality, 4 days of unhealthy air quality for sensitive groups, and 1 day of unhealthy air quality; the data from earlier years are similar.

All three national wildlife refuges are categorized as Class II air quality areas. Class II areas have less stringent air quality standards than Class I areas and may be allowed slight increases in the concentrations of certain air pollutants over baseline conditions. Great Sand Dunes National Park and Preserve, which is located immediately east of the Baca Refuge, is a Class I air quality area. Designated wilderness is found in the park and preserve as well in the Rio Grande National Forest (Sangre de Cristo Wilderness Area), and under the Clean Air Act of 1977, all 156 National Parks and wilderness areas are designated Class I air quality areas.

Air quality data were collected at the park from 1988 to 1992. Information is available from 1988 to 1991 for ozone concentrations and from 1988 to 1992 for sulfur dioxide (SO2). Data from the Interagency Monitoring of Protected Visual Environments (IMPROVE) for visibility (which involved particle sampling at Morris Gulch and a camera near the landing strip adjacent to the south boundary of the Class I area) are available from 1988 to the present. The IMPROVE monitoring program was established in 1985 to aid in the creation of Federal and State plans for the protection of visibility in Class I areas as stipulated in the 1977 amendments to the Clean Air Act (Colorado State University 2013).

The data presented in table 9 show background air quality conditions near the Baca Refuge and include pollution from sources both inside and outside of the refuge (FWS 2011b). The maximum pollutant concentrations are well below applicable Colorado and National Ambient Air Quality Standards (NAAQS) for most pollutants, although maximum concentrations of ozone (as an 8-hour average) that approach the Federal standard have been observed. Given the episodic nature of observed high ozone levels and limitations in photochemical modeling (which is required to simulate the complex mechanisms that govern ozone formation and fate in the lower atmosphere), the exact cause of this pollution is uncertain, although it appears that regional transport plays a role (Western Regional Air Partnership 2008).

We conform to the interim air quality policy for wildland fire (EPA 1998), which is still the most current air pollution control policy. The policy was prepared in an effort to use wildland fire as a tool for managing natural ecosystems while also protecting public health and welfare by mitigating the negative effects of air pollutant emissions on air quality and visibility. Since 2006, our fire management program on the refuge complex has been guided in part by the Greater Sand Dunes Interagency Fire Management Plan (NPS, FWS, TNC 2006). For all prescribed fires we acquire smoke permits, and fires are conducted under strict smoke and air regulations as established by the State of Colorado's air pollution control division (CDPHE 2013). An airshed coordinator and meteorologist evaluate effects of prescribed fire for each airshed to anticipate cumulative impacts. Smoke concerns are addressed in each individual prescribed burn plan. These plans are thorough and discuss specific smoke issues, measures to reduce negative effects, downwind receptors, and smoke vector maps. On average, the refuge complex averages 2 to 3 prescribed fires annually, with each burn averaging about 600 acres. Accidental wildfire is exempted from Clean Air Act compliance. However, when accidental wildfires do occur on the refuge, we notify the State of Colorado's air pollution control division.

Table 9. Background concentrations, ambient standards, and significant impact levels of regulated air pollutants (FWS 2011b).

Pollutant	*Averaging time*	*Background concentration (µg/m³)*	*NAAQS[1] (µg/m³)*	*CAAQS[2] (µg/m³)*	*PSD class I increment (µg/m³)*	*PSD class II SILs (µg/m³)*	*PSD class I SILs (µg/m³)*
Carbon Monoxide[3]	1-hour	2,060	40,000	40,000	NA	2,000	500
	8-hour	1,831	10,000	10,000	NA	500	NA
Nitrogen Dioxide[3]	Annual	8	100	100	2.5	1	0.1
Ozone[4]	1-hour	151	235	235	NA	NA	NA
	8-hour	138	157	157	NA	NA	NA
	Annual	78	NA	NA	NA	NA	NA
	Max. Season[5]	80	NA	NA	NA	NA	NA
	Avg. Season[5]	78	NA	NA	NA	NA	NA
$PM_{2.5}$[6,4]	24-hour	21	35	35	NA	NA	NA
	Annual	4	15	15	NA	NA	NA
PM_{10}[6]	24-hour	50	150	150	8	5	0.3
	Annual	11	50	50	4	1	0.2
Sulfur Dioxide[7]	3-hour	--	1,300	700	25	25	1
	24-hour	3	365	365	5	5	0.2
	Annual	0.2	80	80	2	1	0.1

[1] National Ambient Air Quality Standards

[2] Colorado Ambient Air Quality Standards

[3] Based on the most recent 3 years of data from EPA AIRS database for data collected near Ignacio, CO (rural location), 2005-2007. http://www.epa.gov/aqspub1/

[4] EPA's current PM2.5 implementation policy was finalized 60 days after publication (Aug. 24, 2010) in the Federal Register

[5] From August through April

[6] Based on the most recent 3-years of data available from the IMPROVE station at Great Sand Dunes NPP, 2002-2004. http://vista.cira.colostate.edu/improve/Data/IMPROVE/AsciiData.aspx

[7] Based on historical data collected at Great Sand Dunes NPP, 1988-1991

µg/m³ = microgram per cubic meter; SIL = Significant Impact Level; NA = Not Applicable

Geology and Geomorphology

The San Luis Valley is the largest of a series of high-altitude intermontane basins in the Southern Rocky Mountains (Jodry and Stanford 1996), and is part of the much larger Rio Grande Rift Zone that extends from southern New Mexico north through the San Luis Valley to its northern terminus near Leadville, Colorado (Chapin 1971, Bachman and Mehnart 1978).

The valley is a compound graben depression that was down-faulted along the base of the Sangre de Cristo Mountains during the Laramide Orogeny. The San Juan Mountains, lying to the west, were created by extensive Tertiary volcanism about 28 to 22 million years ago (McCalpin 1996). The Oligocene volcanic rocks of the San Juan Mountains slope gradually down to the San Luis Valley floor, where they are interbedded with alluvial fill deposits (BLM 1991). This layer extends over the Alamosa Horst, a buried ridge of a normal fault, which separates the San Luis Valley into the Monte Vista Graben to the west and the Baca Graben to the east (Bachman and Mehnart 1978). This normal fault line trends north from the San Luis Hills to the Sangre de Cristo Mountains near Medano Pass. The Baca Graben is about 19,000 feet thick, or almost twice as thick as the Monte Vista Graben, because of its proximity to the Sangre de Cristo fault zone (Zeisloft and Sibbet 1985, Burroughs 1981, Brister and Gries 1994). Alamosa Refuge lies at the boundary between the Baca Graben and the Alamosa Horst (Mackelprang 1983).

From the Pliocene to the middle Pleistocene, a large, high-altitude lake, Lake Alamosa, occupied most of the San Luis Valley (Machette et al. 2007) (figure 33). This ancient lake went through several cycles of drying and flooding, which eroded and deposited sediments within the historic lakebed. These sediments have been designated as the Alamosa Formation (Siebenthal 1910). Pliocene and Miocene formations underlie the Alamosa Formation, and are in turn underlain by Echo Park alluvium and then Precambrian rocks. Lake Alamosa existed for about 3 million years before it overtopped a low wall of Oligocene volcanic rocks near the San Luis Hills and carved a deep gorge that flowed south into the Rio Grande, entering at what is now the mouth of the Red River.

More recent drainages, including La Jara Creek and the Alamosa River, originate from the San Juan Mountains and flow across alluvial fans onto the floor of the San Luis Valley, where they empty into the Rio Grande on the Alamosa Refuge; these tributaries have deposited substantial amounts of alluvial material on what are now refuge lands.

The Rio Grande flows through the Alamosa Refuge and is a dominant feature of the southern San Luis Valley. The Rio Grande enters the valley near Del Norte, Colorado, and flows to the south and east along the southern boundary of the Rio Grande alluvial fan. The area where the Rio Grande enters the valley is bounded by a low-elevation terrace on the south and west sides, which allows the channel to avulse to the northeast of the town of Monte Vista, Colorado, and which has in turn created a floodplain 200 to 300 times the width of the current average river channel (Jones and Harper 1998). The river takes a more southerly direction at the town of Alamosa, Colorado, where a low topographic and hydrologic divide separates the Rio Grande floodplain from the closed basin to the north. After turning south, the Rio Grande is confined to the east by Hansen's Bluff, which is also the eastern boundary of the Alamosa Refuge (Jones and Harper 1998). Hansen's Bluff is an outcrop of the Alamosa Formation and consists of younger Quaternary alluvium with surficial deposits overlaying the formation (Rogers et al. 1992).

The Baca Refuge is in the northeast part of the closed basin of the Baca Graben. The closed basin depression may be a result of subsidence and wind deflation which, over time, prevented external surface drainage to the Rio Grande.

Minerals

The most recent mining activities in the general vicinity of Crestone, Colorado, have been by Battle Mountain Gold Company at its San Luis Mine, which is located more than 50 miles southeast of Crestone in Costilla County and which ceased operations in late 1996; and by Galactic Resources, Inc. at its Summitville Mine, which is located more than 60 miles southwest of Crestone in Rio Grande County and which ceased operations in late 1992. In the immediate vicinity of Crestone, the last recorded mining

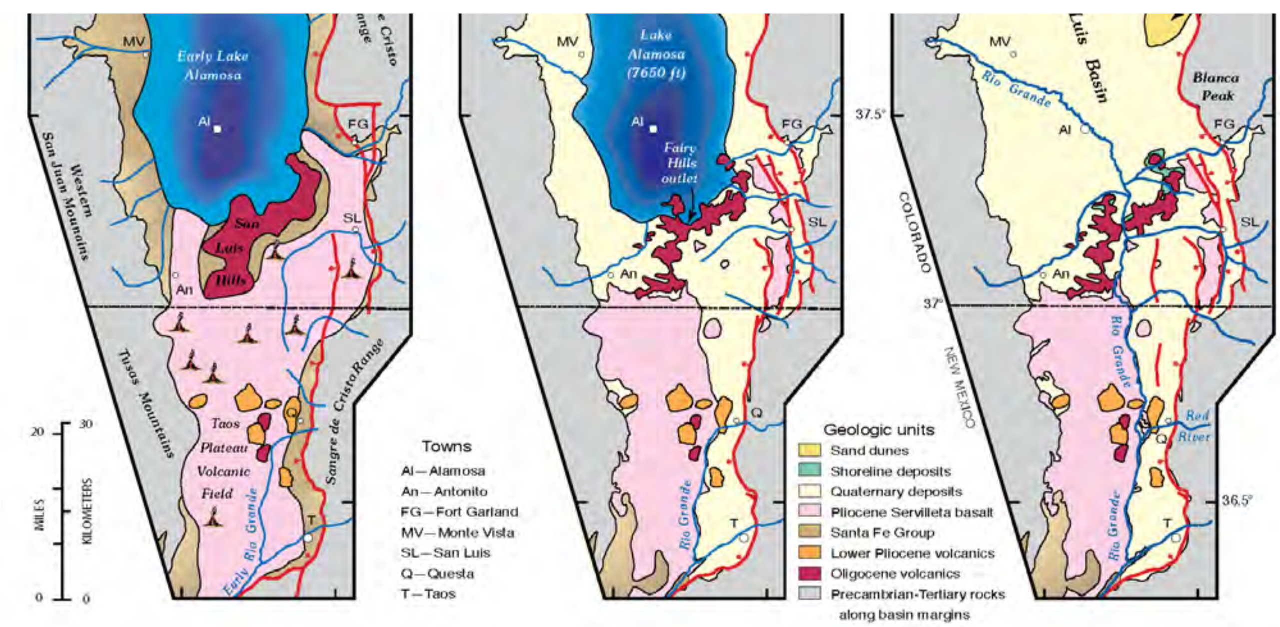

Figure 33. Simplified geological map of the San Luis Basin showing generalized geology and drainage patterns for the time intervals A) 3.5-5 million years before the present (BP); B) 440,000 years BP; and C) current.

Source: Machette et al. 2007

took place in the late 1800s. Prospecting for gold and silver occurred throughout the Sangre de Cristo Mountains, and Crestone itself was founded where there was a small producing ore body. Production here was sufficient to support the construction of a stamp mill at the location; however, the mine soon played out (FWS 2011b).

Sand and gravel are the major mineral commodities that are mined in the valley (Guilinger and Keller 2000). The nearest sand and gravel pits are located a couple of miles north of the refuge complex. Other sand and gravel operations are scattered around the valley and are concentrated around the towns of Alamosa and Del Norte. Other minerals that are mined in the area include gold, silver, peat, and limestone. In 2006, there were no active mine permits issued or pending mine permits in Saguache County (Cappa et al. 2007). Only 46 mining claims were recorded in the county compared with 5,693 for the entire State. No minerals are now being produced from the refuge complex (FWS 2011b).

In 2011, the Service approved an application for exploratory drilling on the Baca Refuge (FWS 2011b) for two wells to explore for oil and gas beneath the surface estate. To date this activity has not taken place.

Soils

More than 30 soil series and land types are present on the Monte Vista Refuge (figure 34), and their distribution reflects three major landforms: the San Juan Range foothills; the large Rio Grande alluvial fan; and Spring, Rock, and Cat Creeks and their associated floodplains. Loamy sands dominate the Rio Grande alluvial fan, which was once vegetated with shrubs (USDA Soil Conservation Service 1980). Some clay loam soils are present on the refuge and indicate former wetland areas (USDA Soil Conservation Service 1980). Cobbly and gravelly loams are present along relict stream courses and terrace edges. (Heitmeyer and Aloia 2013c).

About 29 soil series and land types are present on the Alamosa Refuge (figure 35). There are three major soil associations on the refuge: the Alamosa-Vastine-Alluvial association, which is on floodplains; the Hapney-Hooper-Corlett association, which is in hilly or dune areas; and the Costilla-Space City association, which is on Hansen's Bluff. Soil distribution across the refuge generally reflects the movement of the Rio Grande across its floodplain as well as the deposition and movement of sediments where creeks joined the Rio Grande (USDA Soil Conservation Service 1973).

The Alamosa-Vastine-Alluvial association, which formed on the floodplains of the Rio Grande and its tributaries, covers most of the Alamosa Refuge. These soils and land types cover the largest amount of area on the refuge and are usually associated with seasonal wet meadows in floodplain margins. This association is characterized by deep, dark soils that are commonly flooded in the spring and that have a high water table that creates somewhat saline conditions. The typical surface texture in these soils is loam, but sandy or clayey areas may also be found. Alluvial land is material that has been recently deposited, and it is characterized by stratified layers with little or no soil development. Loamy alluvial land occurs in the central and southern areas of the refuge, and makes up 16.5 percent of the total refuge area. Sandy alluvial land is restricted to natural levees along the active channel of the Rio Grande and covers only 2.2 percent of the area. Vastine soils cover 12.1 percent of the refuge and Alamosa soils cover 9.8 percent of the refuge. Marsh soils are also within the Alamosa-Vastine-Alluvial association and occupy a small area along the toe of Hansen's Bluff and in a few areas throughout the floodplain (Heitmeyer 2013a).

The northeastern part of the Alamosa Refuge contains soils of the Hapney-Hooper-Corlett association, which is characterized by moderately fine- to coarse-textured alkali soils that are moderately well to somewhat excessively drained and are on nearly level to hilly sites. The dominant soil series in this association are calcareous and strongly alkaline. Sandy dunes are present in scattered locations throughout this association.

The eastern part of the Alamosa Refuge along Hansen's Bluff has the Costilla-Space City association, which occurs on gently sloping topography and which has coarse-textured soils that are well drained.

About 37 soil series and land types are found on the Baca Refuge (Heitmeyer and Aloia 2013b) (figure 36). Generally, soil distribution across the Baca Refuge reflects the movement, deposition, and scouring of sediments carried by ephemeral creeks that originate in the Sangre de Cristo Mountains; avulsion movements of San Luis Creek; and wind deflation (USDA Soil Conservation Service 1981). Wind deflation of basin sediments has brought the ground water close to the surface through removal of particles. Salts are brought to the surface through capillary action, which alters the salinity of surface water and subsequent particles that are transported by wind. Wind deflation of the sabkha and eolian sand sheet has created playa lakes throughout the western and southern parts of the refuge (as can be seen in the partial 1941 aerial photo, figure 12) and in the dune fields. The wind deflation of the sump area has also created dunes nearby (Madole et al. 2008).

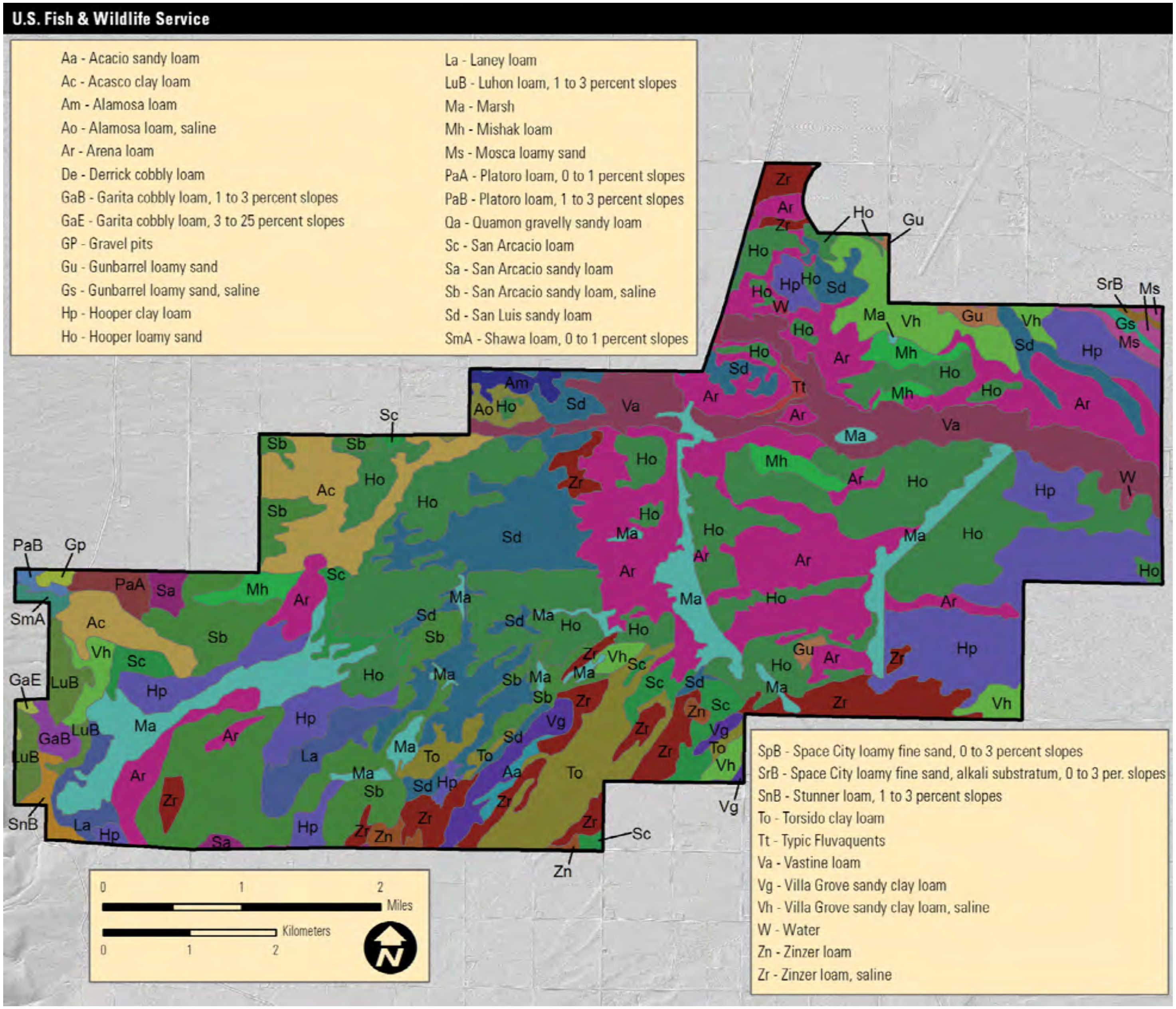

Figure 34. Soils map for Monte Vista National Wildlife Refuge, Colorado.

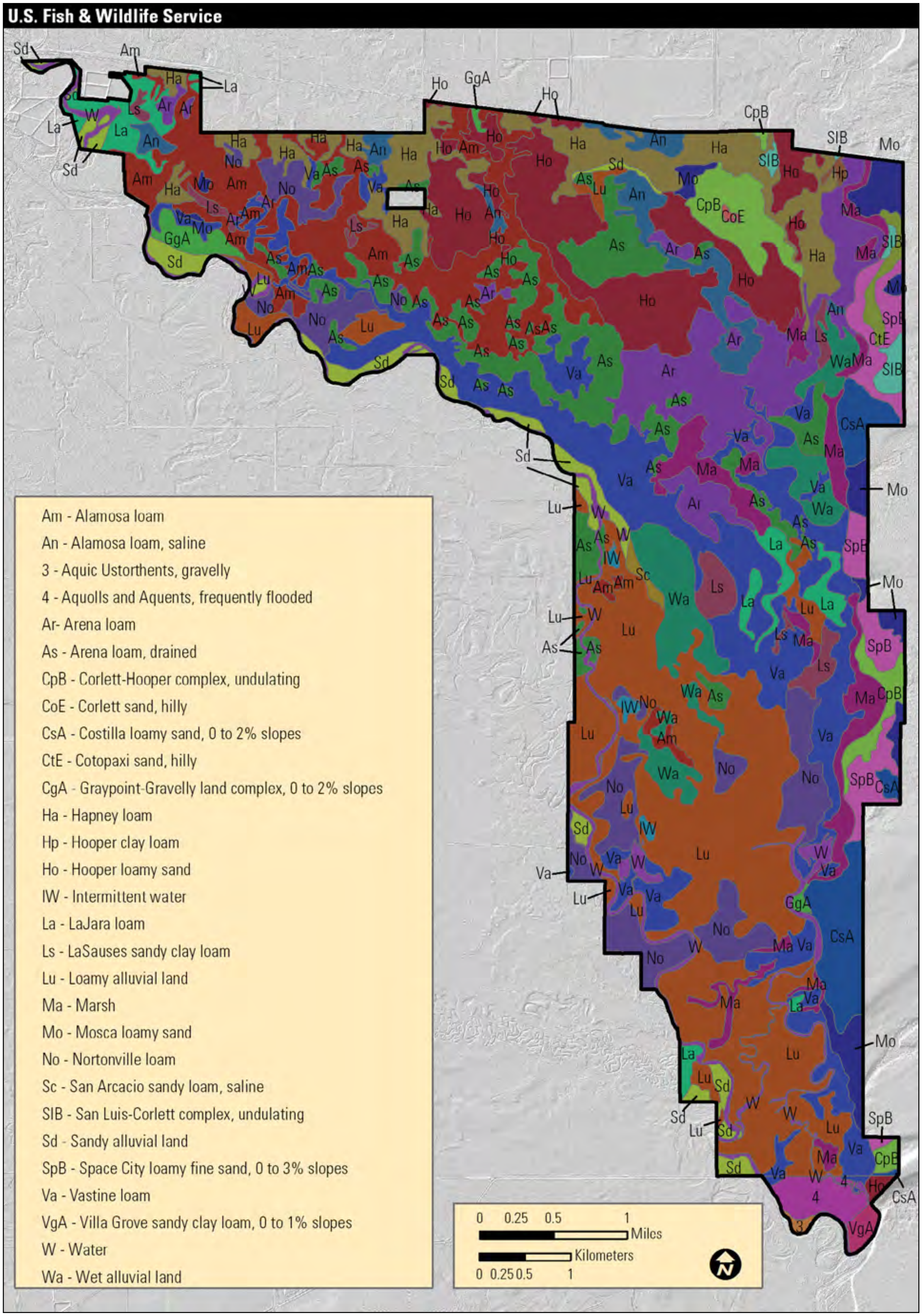

Figure 35. Soils map for Alamosa National Wildlife Refuge, Colorado.

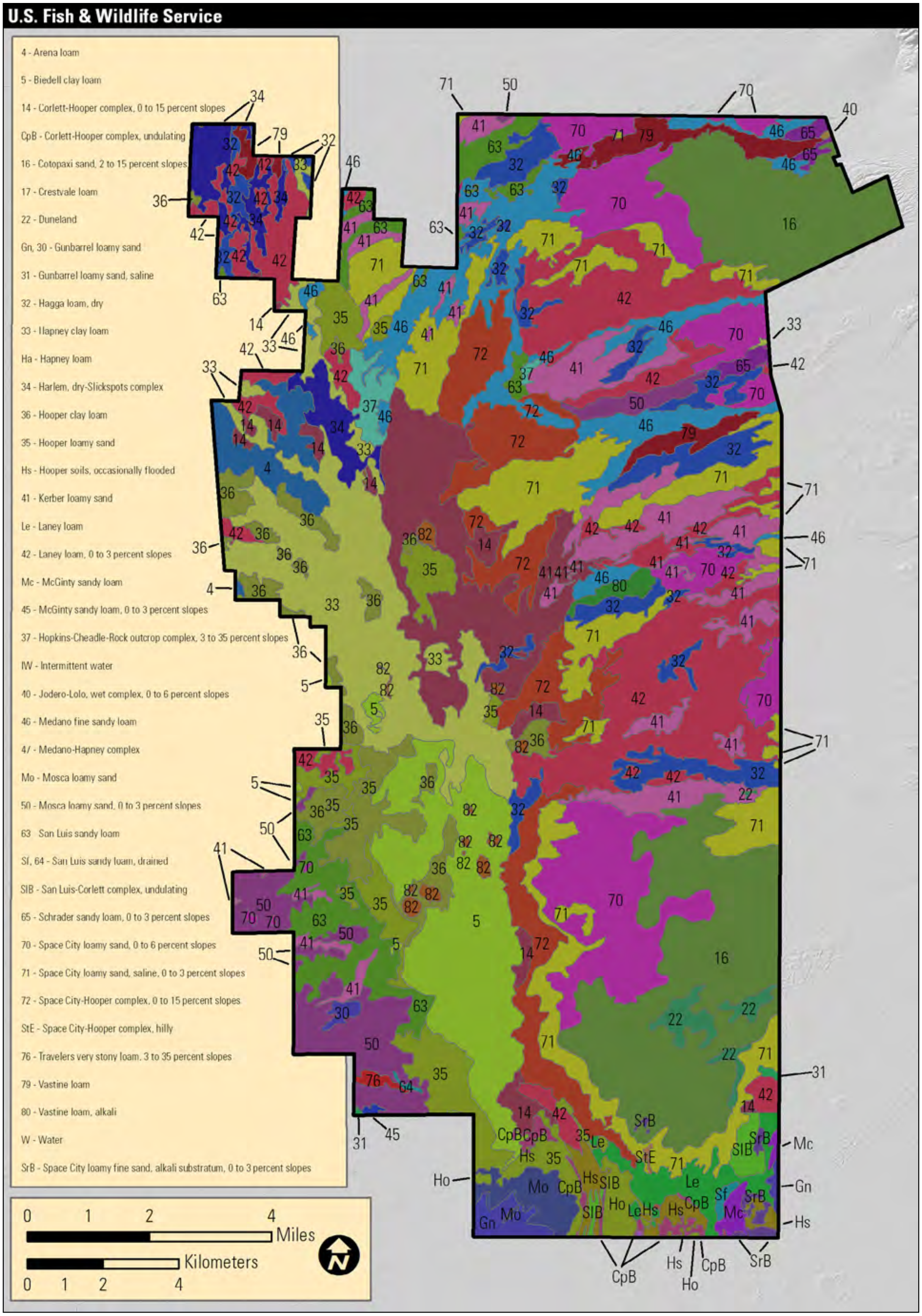

Figure 36. Soils map for Baca National Wildlife Refuge, Colorado.

The Baca Refuge is dominated by three soil associations: Space City-Cotopaxi, which is in the eastern and southern parts; Big Blue-Gerrard, which contains the floodplain of San Luis Creek and most of Cottonwood Creek; and Hooper-Hagna-Hapney, which is west and east of the Big Blue-Gerrard association (USDA Soil Conservation Service 1981).

The Space City-Cotopaxi association is characterized by deep soils that occur on level to moderately sloping land in dune-like topography that is intersected by intermittent streams. Soils in this association have a texture of loamy sand or sand and are underlain by calcareous loamy sand or sand, and they are somewhat excessively drained. Dominant soil series include Space City, Cotopaxi, and Laney. Space City soils occur on 0-15 percent slopes and cover about 22 percent of the Baca Refuge. Cotopaxi sand is on 2-15 percent slopes on dune-like hills and covers 11.5 percent of the refuge. Laney loam is on 0-3 percent slopes on floodplains and fans, formed in calcareous alluvium with saline-alkali characteristics, and covers about 12 percent of the refuge. Grasses and shrubs are typical vegetation found on Space City-Cotopaxi soils (USDA Soil Conservation Service 1973).

The Big Blue-Gerrard association occurs on floodplains along streams on the Baca Refuge and consists of clay loam or loamy surfaces underlain by clay loam and gravelly sandy clay loam. These soils have seasonal high water tables and may be flooded for short periods (USDA Soil Conservation Service 1981). This soil association occurs within the Upper Sump area, which is where most of the playa lakes occur and where ephemeral creeks empty onto the San Luis Creek floodplain.

The Hooper-Hagna-Hapney association on the Baca Refuge includes deep, typically saline-sodic soils on nearly level surfaces of floodplains and terraces. The two major soils of this association, Hooper and Hapney clay loam, each cover about 7 percent of the Baca Refuge (Fig. 13). The water table in these areas is generally high during the spring and summer and historically supported salt desert shrub and salt-tolerant grassland communities; some of these areas are in relict lake basins (USDA Soil Conservation Service 1973). Laney loam, mentioned above, also can occur within the Hooper-Hagna-Hapney areas.

Water Resources

Water is vital for life in the San Luis Valley. Irrigation water converts arid desert ecosystems into productive farmland and hay fields that support livestock, and it is essential for the farming and ranching communities that have defined the character of the area for over 150 years. Water also supports a vibrant resident wildlife population. It is the driving force that forms many unique natural features, including the sand dunes at Great Sand Dunes National Park and Preserve, the playa wetlands and lakes, and the riparian zones along the creeks and rivers.

Water resources include both surface and ground water. Surface water is the result of snow melt in the Sangre de Cristo and San Juan Mountains, intense summer rainstorms, and irrigation return flow from agriculture fields. Ground water comes from a complex aquifer system that has confined and unconfined portions, with artesian flows common. Topographically, the Rio Grande river system dominates the landscape, entering the San Luis Valley from the west and exiting to New Mexico at the south. The valley north of the Rio Grande contains a closed basin. Without a natural surface water outlet, the closed basin acts as a catchment basin, collecting meltwater and rain in a shallow unconfined aquifer. Surface water rarely persists except as playa wetlands, where clay soils impede infiltration. Figures 37, 38, and 39 show how various flow paths for water cross the three refuges.

Hydrology

The Rio Grande is the fifth longest river in North America and the largest river in the San Luis Valley. It starts in the San Juan Mountains above Creede, Colorado, and flows southeast through the towns of South Fork, Del Norte, Monte Vista, and Alamosa, Colorado, and then south to the Colorado State line and into New Mexico (figure 6). Tributaries to the Rio Grande include the Conejos River, Rock Creek, La Jara Creek, and Trinchera Creek. The Rio Grande has an extensive network of storage dams and diversions for irrigation, flood control, and regulation of river flow along its entire length. Rio Grande flow has been regulated by Beaver Creek Reservoir since 1910, Santa Maria Reservoir since 1912, Rio Grande Reservoir since 1912, and Continental Reservoir since 1925, as well as by several smaller reservoirs. The combined capacity of these reservoirs is more than 126,000 acre-feet. These storage reservoirs and other diversions of and changes to the Rio Grande have reduced flooding, but they have also depressed flows during the spring and early summer and led to more prolonged flows throughout the remainder of the year.

The headwaters of the Rio Grande are above the town of Del Norte, Colorado, in the nearby San Juan Mountains. Near the point where it passes Del Norte, the Rio Grande receives surface and subsurface drainage from about 1,320 square miles. There is an extensive history of mining in the upper watershed,

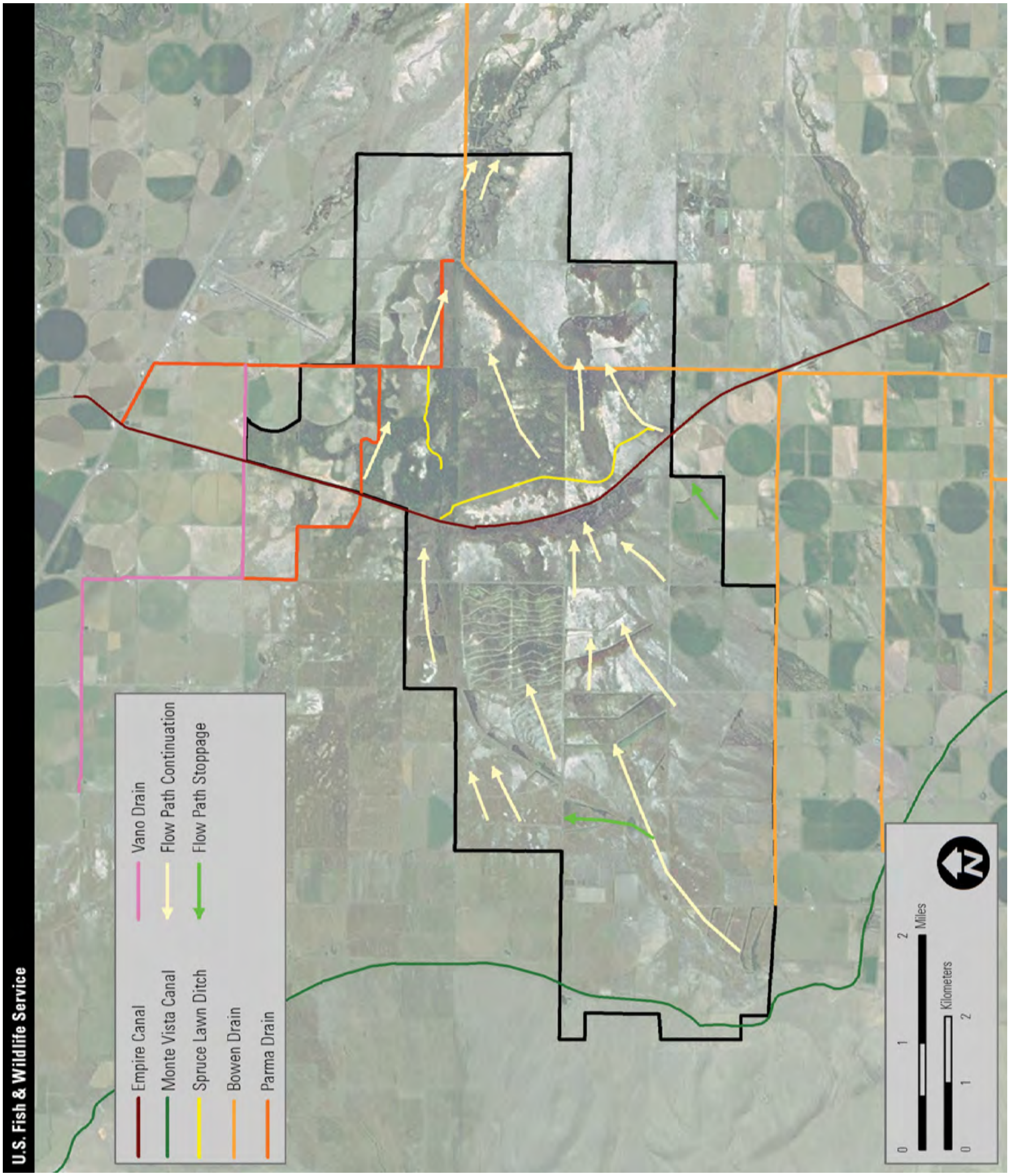

Figure 37. General water flow paths for Monte Vista National Wildlife Refuge, Colorado.

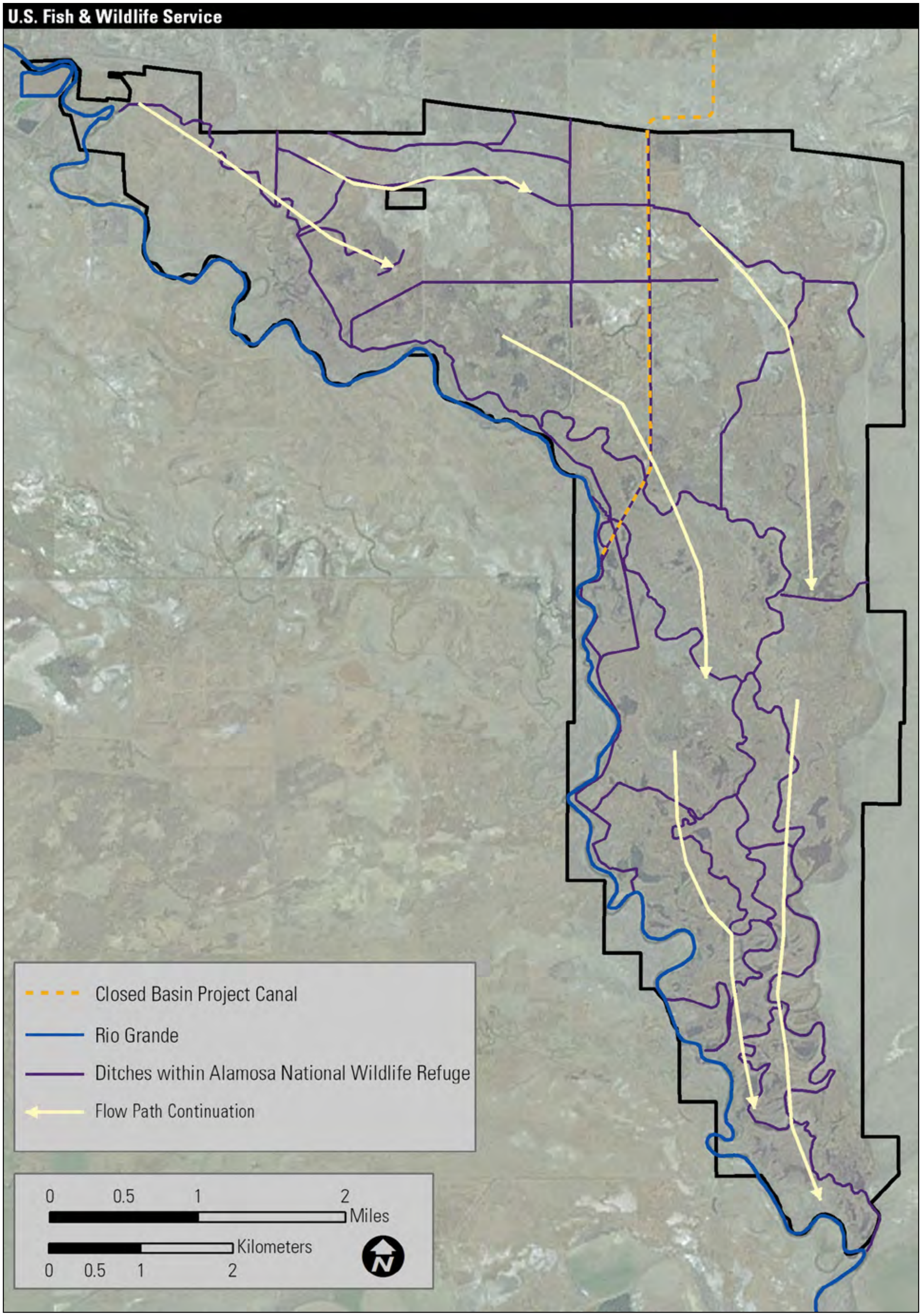

Figure 38. General water flow paths for Alamosa National Wildlife Refuge, Colorado.

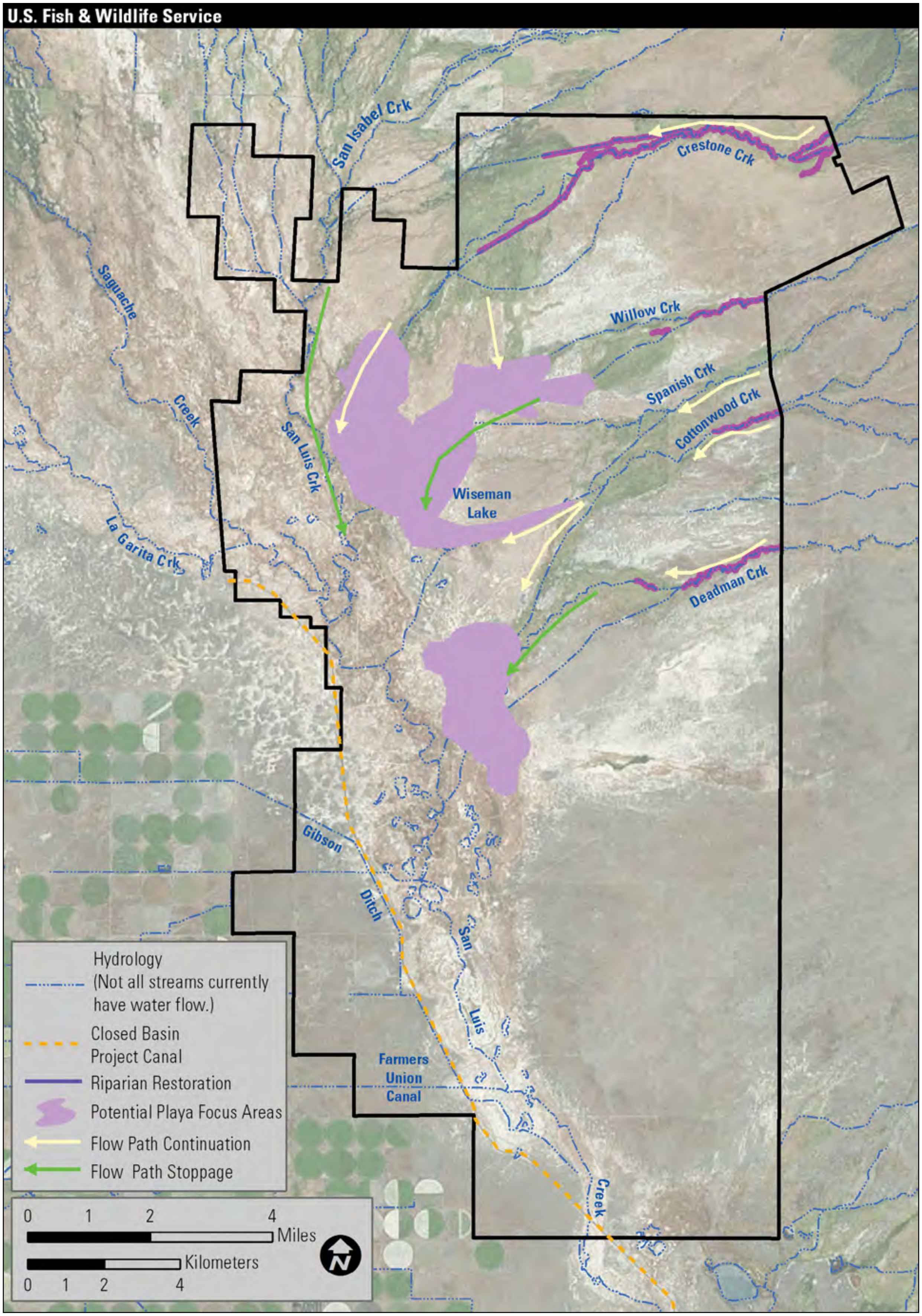

Figure 39. General water flow paths for Baca National Wildlife Refuge, Colorado.

which may still affect water quality in the Rio Grande. From Del Norte, the river passes through predominantly irrigated agricultural land, with the possibility of return flow and associated agricultural chemicals entering the river.

By the time the Rio Grande reaches Monte Vista, the drainage area has increased to 1,590 square miles, and at Alamosa, it has increased to 1,710 square miles. Besides agricultural return flow, water is returned to the river from municipal water treatment facilities and urban runoff, including a golf course in Alamosa. The Empire Canal drains into Rock Creek, but Rock Creek rarely has significant flow by the time it reaches the Rio Grande because the water is diverted for irrigation. La Jara Creek channel joins the Rio Grande at the southern end of the Alamosa Refuge.

The Rio Grande and its tributaries support riparian vegetation along much of their courses, though the cottonwood galleries along the rivers have been in decline for decades. Riparian vegetation is significant for its ability to conserve soil, and for its influence on habitat diversity and aquatic ecosystems. Riparian zones are instrumental in the denitrification of agricultural return flows, and improve water quality by reducing sedimentation and controlling stream temperatures. The water that supports the riparian vegetation comes from seepage and overbank flows as well as return-flow from irrigation ditches and drains. Some discontiguous attempts to restore riparian function have been made by restricting grazing; planting and protecting riparian vegetation; and engineering streambank protection.

The thick basin-fill deposits in the San Luis Valley consist of inter-bedded clay, silt, sand, gravel, and volcanic rock. These form many separate aquifer systems, which are generally grouped into the two major aquifers: a shallow unconfined aquifer and a deep confined aquifer. Combined, these two aquifer systems are contained in deposits that can be as much as 30,000 feet thick (Brendle 2002). The confined aquifer is separated but not totally disconnected from the unconfined aquifer by clay layers and lava flows. The unconfined aquifer is recharged through infiltration of precipitation, irrigation water, runoff, and upward seepage of ground water from the confining bed. Discharge from the unconfined aquifer is from ground water withdrawals, ground water flow to the south, discharge to streams or drains, and evapotranspiration. Water levels in the unconfined aquifer respond to localized rain events.

Wells drilled into the deep confined aquifer are frequently artesian and are buffered from short-term weather conditions. The confined aquifer is recharged from precipitation and snowmelt in the high San Juan and Sangre de Cristo Mountains. Discharge from the confined aquifer is from ground water withdrawals, ground water flow to the south, and upward percolation through the confining bed (The Water Information Program 2012). Wells and diversions for each of the three refuges are shown in figures 40, 41, and 42.

Siebenthal (1910) provides a description of geology and water resources in the San Luis Valley. The eastern limit of the “flowing well area” is in a strip 3 miles wide at the north end and about 5 miles wide in the south and is described as passing through the Baca Refuge and including the playa wetlands area along the western boundary. This area is now known to be broader and extend much further north (R. Cotten, personal communication with planning team, April 21, 2014). The occurrence of natural gas in wells is associated with colored water and coincides with the natural sump area in the San Luis Valley. As distinct as the water and gas occurrence is in this trough, Siebenthal presents evidence for the continuity of the gas-bearing aquifers to the regional ground water aquifers boasting high-quality ground water (Siebenthal 1910).

The San Luis Valley Closed Basin

The San Luis Valley closed basin covers about 1,500 square miles. Closed basins are defined by geographical barriers that prevent drainage out of the basin. In the San Luis Valley, the closed basin is bound on the north end by the convergence of the San Juan and Sangre de Cristo Mountain ranges, and on the south by a low topographical divide north of the Rio Grande. Because the main outflow pathways from the closed basin are primarily evapotranspiration and seepage, the closed basin can accumulate contaminants and environmental pollutants.

The BOR Closed Basin Project was authorized by Congress in 1972 through PL 92-514, (92 Congress, S. 520, 1972) and amended through PL 96-375 in 1980, PL 98-570 in 1984, and PL 100-516 in 1988. The Closed Basin Project is part of the greater San Luis Valley Project, which includes Platoro Reservoir in the Conejos River watershed. Platoro Reservoir was built to control floodwater and provide supplemental water for irrigation. The Closed Basin Project reclaims shallow ground water that would normally be lost to evapotranspiration. Powell and Mutz (1958) found that the shallow water table was within 5 feet of the surface in an area of about 120 square miles within the sump area (Powell and Mutz 1958), an area that includes the Baca Refuge (figure 47). This sump area was targeted for salvage pumping by the Closed Basin Project. Salvaged ground water is carried out of the closed basin to the Rio Grande. The Closed Basin Project’s objectives include helping Colorado to meet annual water deliveries under the Rio Grande Compact; preserving the Alamosa Refuge and the Blanca Wildlife Habitat Area; stabilizing the San

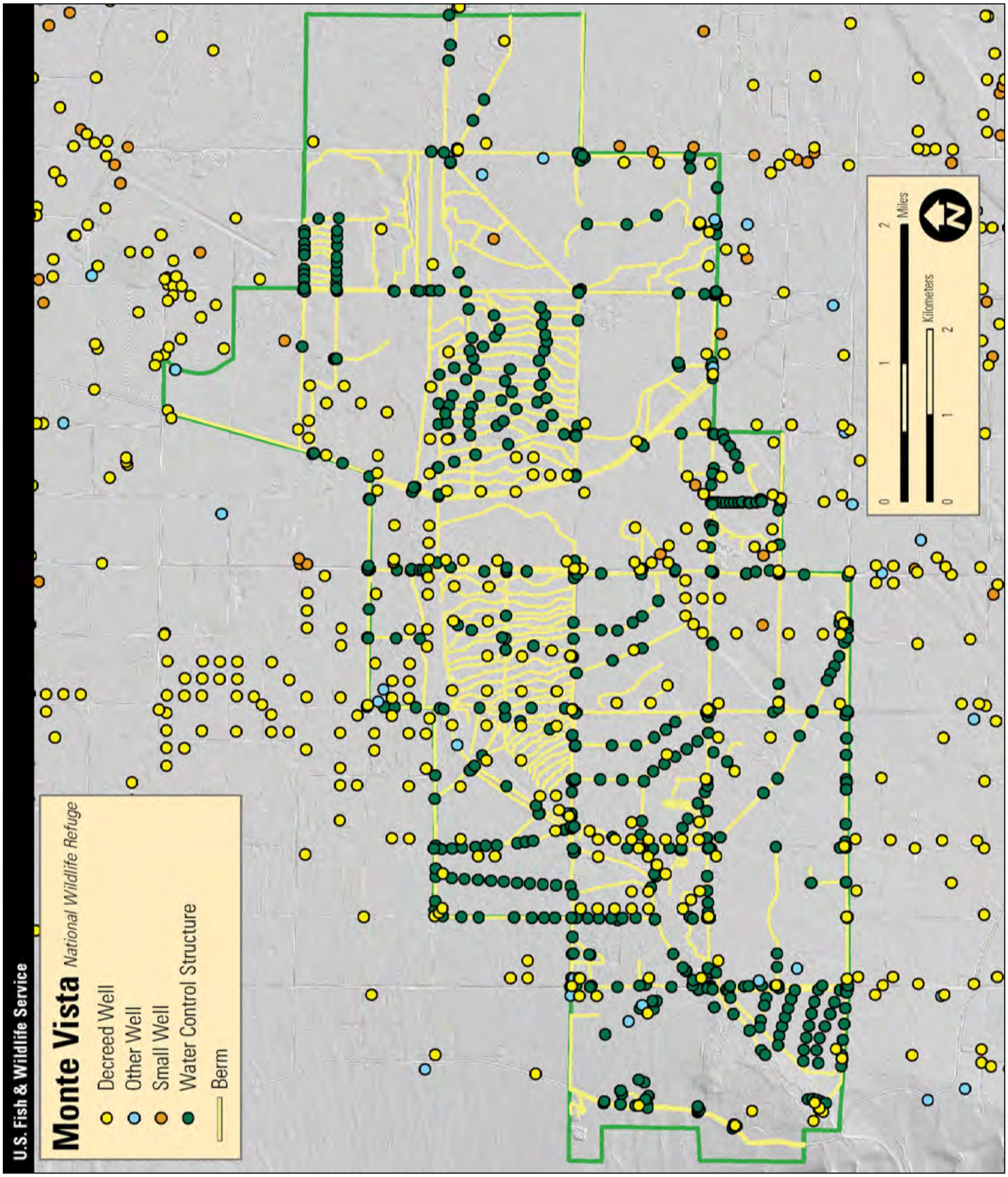

Figure 40. Water wells and diversions for Monte Vista National Wildlife Refuge, Colorado.

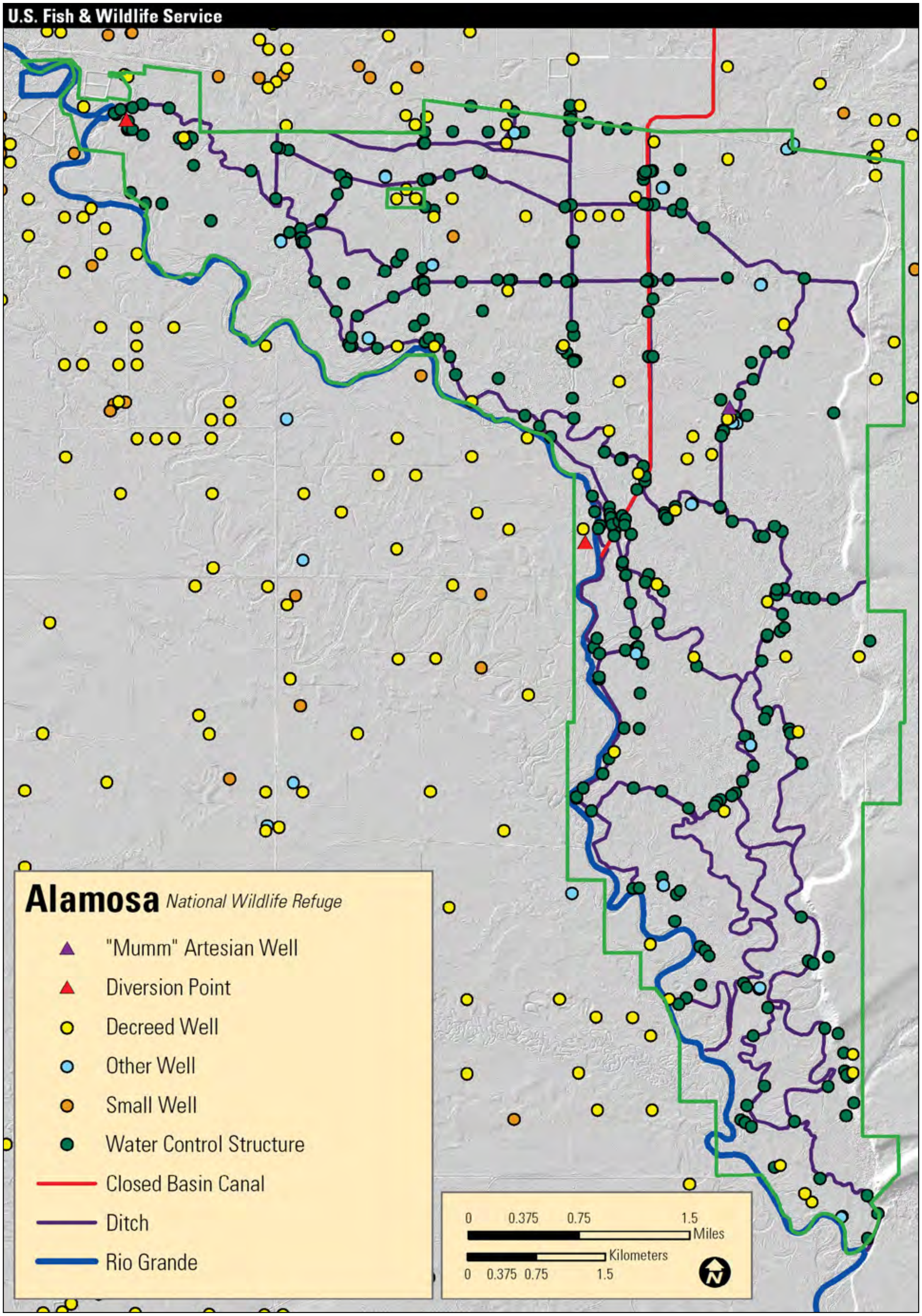

Figure 41. Water wells and diversions for Alamosa National Wildlife Refuge, Colorado.

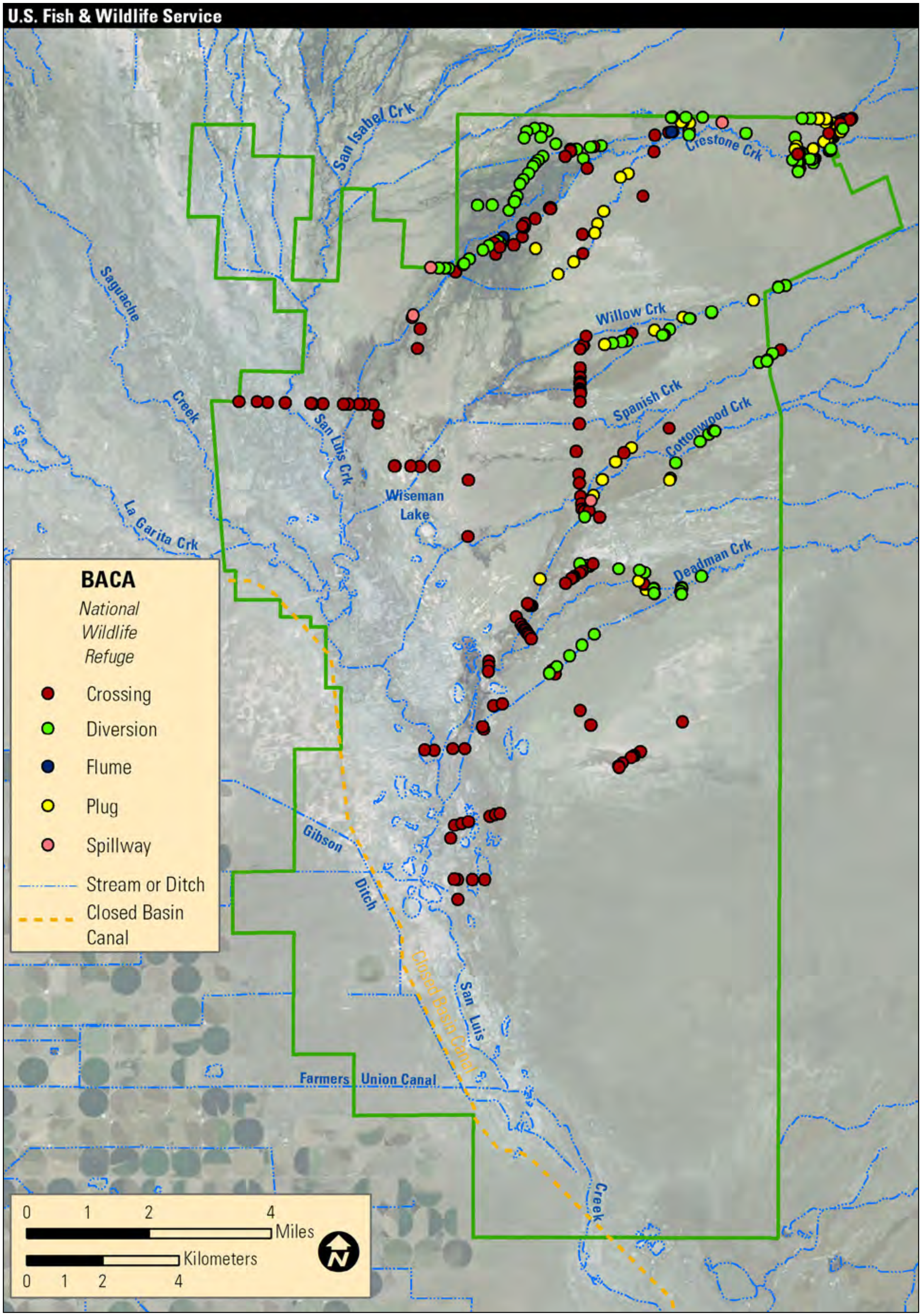

Figure 42. Water wells and diversions for Baca National Wildlife Refuge, Colorado.

Luis Lakes; and providing irrigation water and other beneficial uses.

Congressional authorization of the Closed Basin Project included a stipulation that limits how much Closed Basin Project pumping can lower the area's water table. The Closed Basin Project "*will not cause the water table available for any irrigation or domestic wells in existence outside the project boundary prior to the construction of the project to drop more than two feet.*" The project will be operated "*in a manner that will not cause reduction of artesian flows in existence prior to the construction of the project.*" The project is required to maintain a system of observation wells, designed to "*provide positive identification of any fluctuations in the water table of the area surrounding the project attributable to operation of the project or any part thereof*" (92 Congress, S. 520 1972).

The Closed Basin Project covers only about 200 square miles of the 1,500 square mile closed basin in the San Luis Valley. The Closed Basin Project consists of 170 salvage wells, 132 monitoring wells, 115 miles of pipeline, and a 42-mile-long polyvinyl chloride (PVC) lined canal. A former manager for the Closed Basin Project (Hildner 2011) said that the Closed Basin Project yields 15,000 to 20,000 acre-feet per year (AFY) of the 117,000 AFY design capacity, which is 15 percent of the design capacity. Of the 170 salvage wells, only about 90 operate at one time, and some wells are not used because of water quality concerns. The Sangre De Cristo runoff, initially projected at around 8,000 AFY, has been closer to 2,000 AFY (Hildner 2011). The water levels in the unconfined aquifer in the closed basin are declining and withdrawals are exceeding recharge (Rio Grande Water Conservation District 2012a). Nearly a third of the Closed Basin Project salvage wells lie in the playa wetlands area along the west side of the Baca Refuge. Figure 48 shows the wells that lie within the Closed Basin Project and the hundreds of wells, miles of canals, and six major creeks found within or adjacent to the Baca Refuge.

The first salvage wells were constructed between 1986 and 1992. Between 1992 and 2000, productivity began to decline because of biofouling of well screens, pumps, and transmission lines caused by iron bacteria and manganese deposits. Beginning around the year 2000, salvage wells for the Closed Basin Project were redrilled in the same locations to regain productivity. Biofouling again affected well productivity, and by 2012 the third round of drilling began. For this third round of drilling,BOR moved the well locations and called for higher capacity wells, with production capacity increasing from 100 gallons per minute (gpm) to 420 gpm. Drilling the new well-field began in 2012 with the wells furthest east drilled first.

Though the new salvage wells for the Closed Basin Project have a higher capacity design, pumping is planned to be intermittent; it is suspected that continuous pumping leads to more biofouling (personal communication, Pete Striffler, February 2013). However, as more wells are being shut down and the productivity of older wells is reduced by bio-fouling across the project, more reliance is focused on wells with the newer design, and continuous pumping of the 2012 wells is providing most of the Closed Basin Project salvage water.

The Closed Basin Project threatens water-dependent wildlife habitat across most of the closed basin. By focusing their salvage pumping on the playa wetlands area, the most extreme ground water level declines attributable to Closed Basin Project pumping occur on the Baca Refuge. Ground water declines have been compounded by insufficient recharge from below average snowpack during dry years in 2011, 2012, and 2013.

Water Rights

The largest reduction in flow in the Rio Grande hydrologic system is from diversions for irrigation. Surface water diversions take water directly out of the river, and ground water diversions cause depletions by lowering local aquifer levels. A complex system of water rights decides who gets to use water first. Interactions between ground water and surface water are complex and poorly understood.

Ground water in Colorado is designated as either tributary or non-tributary. Tributary ground water is water contained in aquifers that have a direct hydraulic connection to surface water. Both the unconfined and confined aquifers in the San Luis Valley are tributary ground water, though the hydraulic connection to the surface water system is poorly understood in the confined aquifer.

Surface and groundwater rights in Colorado are subject to the prior appropriation doctrine: first in time, first in right. The prior appropriation doctrine allows State officials to properly manage and distribute water according to the decreed priority dates. If there is not enough water in a particular stream to satisfy all water right holders, the State may shut off junior right holders as necessary to make sure that senior water right holders receive their full appropriation. The Rio Grande basin is over-appropriated.

The "Rules Governing the Withdrawal of Groundwater in Water Division No. 3" have as their objective "the optimum use of water consistent with the preservation of the priority system of water rights, and protection of Colorado's ability to meet its interstate compact obligations." The use of the confined and unconfined aquifers will be regulated to keep a sustainable water supply, with due regard for the daily, seasonal, and long-term demand for ground water.

The widespread development of ground water-irrigated agriculture in the central valley began in the early 1950s, and water rights associated with the irrigation wells generally carry priority dates from the 1970s. The Rio Grande Decision Support System is a ground water model used to predict the effects of ground water pumping on surface water flows, with specific response functions assigned to each area with similar hydrologic characteristics (response areas). Administration of water rights by the State Engineer's Office will rely on these response functions as a predictive tool for identifying injurious depletions to surface water flows by ground water pumping, and to determine how much depletion is required for a given group of wells. Augmentation plans or any alternatives must also meet aquifer sustainability requirements. The Rules and Regulations allow for the formation of ground water sub-districts within each response area for water users to collaboratively address water use restrictions.

The relationships between the unconfined and confined aquifers and the surface water are not well defined. The purpose of the Rio Grande Decision Support System is to improve the understanding of the aquifer systems and improve estimates of depletions from well users (Colorado Division of Water Resources 2000). The Rio Grande Water Conservation District has gathered well information and water level measurements from their wells, BOR wells, the USGS Groundwater Inventory Database, and the Rio Grande Decision Support System (Davis Engineering Service, Inc.; Principia Mathematica, Inc, 2012). Rio Grande Water Conservation District data allow comparison of water levels through time and examination of well hydrographs. Their data show that there are declining water levels in the unconfined aquifer of the northern San Luis Valley, with aquifer withdrawals exceeding total recharge. The Conservation District emphasizes that the recent water table declines are the result of increased ground water consumption combined with a prolonged drought, and warn that conditions will worsen without reductions in total ground water consumption (Rio Grande Water Conservation District 2012a).

Monte Vista National Wildlife Refuge

Typically, ground water wells that discharge more than 50 gallons per minute (gpm) require metering in the San Luis Valley. On the Monte Vista Refuge, 10 large wells discharge more than 2,000 gpm. Total irrigated acreage permitted from these 10 large capacity wells totals more than 4,700 acres. Thirteen wells discharge between 1,000 gpm and 2,000 gpm, with authorized irrigation on nearly 5,300 acres. Thirty-seven wells discharge at flow rates less than 1,000 gpm. Twenty-two of these wells flow at rates of 50 gpm or less and may not require metering. Eleven wells rated between 75 and 1,000 gpm are inactive and would require maintenance and meters before use. The remaining four wells are active and in use, with meters (figure 40).

Water resources on the Monte Vista Refuge will be affected by the new groundwater rules and regulations that are being developed by the State Engineer's Office. Preliminary estimates of the effects of pumping on the Monte Vista Refuge for wildlife habitat indicate that surface water flow as far away as the Rio Grande and Conejos River systems may be affected. Augmentation of pumping on the Monte Vista Refuge will strain the water resources on the refuge. Joining a ground water sub-district may be necessary to adequately address augmentation needs on the refuge.

Alamosa National Wildlife Refuge

The Chicago ditch and New ditch both get water from the Rio Grande (figure 41). For water rights held by the canal companies, we own all of the water shares in the Chicago ditch. Water available to the refuge from the Chicago ditch is adjudicated for 66.4 cubic feet per second (cfs) through several court proceedings and case numbers:

- October 15, 1934; admin no. 27138
- May 1, 1896; admin no. 11323
- May 1, 1896; admin no. 10788
- The appropriation dates are July 15, 1879, December 31, 1880, and April 20, 1924. Similarly, the Service owns all of the water rights in the New ditch (formerly the Rio Grande ditch) and New ditch enlargement, with 30.43 cfs of water adjudicated through several court proceedings:
- Civil Action 1557; admin no. 19173
- Civil Action 2673; admin no. 32400.31546;
- Case Number April 9,1903; administration numbers 17713 and 16923; multiple appropriation dates June 30, 1890, June 30, 1898, June 30, 1902, and May 15, 1936

The Stewart ditch, the New ditch, and the New ditch enlargement are all segments of the same ditch.

The Shepard ditch has a permanent decree for 1 cfs (case number September 13, 1916; admin no. 23640). It carries seepage from the Costilla ditch, which has a priority date of September 22, 1914, but


USFWS

An example of riparian habitat considered to be in good condition on Baca Refuge. Challenger Peak rises up to over 14,000 from the valley floor.

is not listed in the decrees. The Shepard ditch also carries water from the Closed Basin canal that is diverted from the pumping plant.

The Costilla ditch and San Luis Valley Canal carry water from the Rio Grande. Shares owned by the Service are adjudicated through case numbers and appropriation dates. Water is permitted for use on overlapping areas in the northern parts of the refuge.

The Closed Basin canal brings a valuable water resource to the Alamosa Refuge for wildlife and habitat management outside of irrigation season constraints. Delivery of Closed Basin Project water in the Closed Basin canal is dependent on the production from salvage wells in the closed basin. Availability of the water to the Alamosa Refuge is determined based on the amount of water produced by the Closed Basin Project in a given year. Although it is not a water right, closed basin water is provided to the Alamosa Refuge as mitigation for loss of habitat from Closed Basin Project construction. Water is delivered to the Alamosa Refuge without constraints to place-of-use. The refuge takes water out of the Closed Basin canal from two constant-head orifices and a pumping plant. Water in the Closed Basin Canal that bypasses Alamosa Refuge use is delivered into the Rio Grande near the middle of the refuge. Subdistrict 1, through their approved augmentation plan, provides additional Closed Basin Water to the refuge to make up for out of priority depletions to the Chicago ditch. The volume of water depends on the volume of out of priority depletions.

High capacity ground water wells on the Alamosa Refuge consist of the following:

- 4 Lillpop wells; case number W-2573
  - well #1: 400 gpm; December 31, 1910
  - well #2: 800 gpm; December 31, 1938
  - well #3: 800 gpm; December 31, 1938
  - well #4: 80 gpm; December 31, 1890

- 4 Service wells
  - FWS-25-4A; 100 gpm; December 31, 1906;
  - FWS 28-6A; 100 gpm; December 21, 1947
  - FWS-26-4A; 50 gpm; December 20, 1948;
  - FWS-29-4A; 50 gpm; December 12, 1949), and

- The Mumm well (FWS-23-20A; 2,865 gpm; September 18, 1958).

All of the other wells on the refuge are low-capacity domestic and stock use wells with localized places of use. Only the Mumm well is now being used by the refuge. The refuge may have sufficient surface water rights to provide augmentation water for ground water used from the Mumm well depending on what streams or rivers are determined to be affected based on the response functions. Though the full effects of pumping will not be known until release of the response functions, ground water pumping from the Mumm well may influence both the Rio Grande and the Trinchera Creek hydrologic systems.

Baca National Wildlife Refuge

The Baca Refuge relies heavily on surface water from small creeks that flow out of the Sangre de Cristo Mountains. Water rights were appurtenant to lands acquired with the Baca Refuge property and carry senior priority dates ranging from June 1, 1869, to May 1, 1949. Total adjudicated flow for all water rights on surface water is more than 620 cfs, but most of that is available only seasonally. Because some of these creeks may not flow during dry years, the refuge usually does not get its full water right.

The water rights database maintained by the Service in Region 6, Division of Water Resources, lists 134 wells on the Baca Refuge (figure 42). Fifteen wells are permitted for irrigation use only, 22 wells are for observation or monitoring, 82 wells are livestock wells, and 7 wells are permitted for domestic or municipal use. Twelve wells have multi-use permits, including stock and irrigation or irrigation and domestic uses. Eighty wells are described as confined aquifer wells, 24 are described as unconfined aquifer wells, and 30 do not have an aquifer associated with them in the record.

Some of the water rights are subject to a preexisting lease agreement with the Baca Grande Water and

Sanitation District. This agreement requires that the refuge lease to the District up to 4,000 acre-feet of water annually, primarily for irrigation; fire; and domestic, municipal and recreational uses if the District demonstrates the need. Legislation establishing the Baca Refuge provides for the sale of water rights in order to terminate the lease agreement. Two of the wells are drilled in the unconfined aquifer, one is an alternate point of diversion for one of these two wells, and the Golf Course Well is an alternate point of diversion for Baca Grant ditch 7. Under the lease agreement, we do not own and are not responsible for maintaining the infrastructure enabling water delivery, but could be required to provide replacement water for the wells drilled in the unconfined aquifer under an augmentation plan. Options to relieve this burden on Service resources are being negotiated with the Baca Grande Water and Sanitation District.

We may own sufficient surface water rights for augmentation water to replace ground water pumping, depending on what the response functions show. The legislation establishing the Refuge prohibits the use of Baca surface water for anything other than the historic use, and this may affect the Refuge's ability to use surface water for augmentation. It currently appears unlikely that there will be a Subdistrict developed that would cover the Baca refuge.

Water Quality Monitoring

Water quality in the Rio Grande system is driven by the chemical conditions in the drainage basin. Sub-surface mining was a historically important industry in the high San Juan Mountains, and some mining continues today. Some water quality concerns may be attributable to mine drainage. Water chemistry in the Rio Grande at Del Norte is predominantly calcium bicarbonate ($Ca(HCO3)2$) type with the silica concentration of secondary importance (USGS 2011a). Soluble calcium bicarbonate is formed when excess carbon dioxide in rainwater reacts with limestone, a process that increases on mine tailings. The EPA assessment data for the Rio Grande headwaters watershed in 2008 list impaired conditions on the mainstem of the Rio Grande below Willow Creek (EPA 2008) for cadmium and zinc, and the probable source is listed as abandoned mine lands. Because of runoff from abandoned mine lands, the EPA has listed the Rio Grande from Del Norte to Monte Vista as impaired due to copper. The designated use group for the impairments is for fish, shellfish, and wildlife protection and propagation. No Total Maximum Daily Loads (TMDLs) apply to this water-body. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards.

Three EPA Clean Water Act facilities exist along the Rio Grande between Del Norte, Colorado, and the Alamosa Refuge: the Town of Del Norte; the City of Monte Vista Henderson Lagoon Facility in Monte Vista, Colorado; and the Regional Waste Water Treatment Facility in Alamosa, Colorado. These are all sewage systems operating under National Pollutant Discharge Elimination System permits. Recent inspection reports are available from the EPA (EPA 2012a). Violations of the Clean Water Act at the Del Norte Facility (EPA, 2012) are limited to pH limit violations in January 2009 (pH=9.36) and again in April 2011 (pH=9.06), and violations of biological oxygen demand limits in monthly gross effluent outfall samples. Biological oxygen demand is used to gauge the effectiveness of wastewater treatment plants and is a surrogate of the degree of organic pollution in water (EPA 2012a).

Similarly, violations were reported for the Monte Vista Henderson Lagoon Facility for pH (10.8, April 2010, and 10.7, May 2010) and biological oxygen demand concentration (57 mg/l, April 2011) (EPA 2012a). The Regional Waste Water Treatment Facility in Alamosa, Colorado, reported violations of biological oxygen demand concentration (93 mg/l, April 2011), and biological oxygen demand percent removal (below 85 percent, April 2011) (EPA 2012a). Additional violations were reported that related to reportable noncompliance, cadmium concentration, copper concentration, and lead concentration.

The environmental assessment for proposed oil and gas exploration (FWS 2011b) compares USGS water quality data from 1967-1968 with more recent data from 2008 and concludes that water quality conditions have not changed appreciably over the past 40 years. The pH values are fairly neutral, the major cation is calcium, and the major anion is bicarbonate. Additional sampling as part of a baseline sampling program did not detect gas or diesel in any of the samples, found methane in all of the Spanish Creek samples, and found volatile organic compounds in two samples from Willow Creek.

Crestone and South Crestone Creeks receive sewage effluent from the Aspen Institute Waste Water Treatment Facility. A recent study of fathead minnows collected from Crestone and South Crestone Creeks found that pharmaceutical and personal care products are being found at low concentrations; however, some products have the potential to be potent. Pharmaceuticals found include antiepileptics, antidiabetics, antibiotics, and antidepressants (Sanchez et al. 2012).

Head Lake, Soda Lake, and the San Luis Lakes, which are in the sump area of the closed basin, vary seasonally, with dissolved solids ranging from 223 to 17,100 milligrams per liter (mg/l), total hardness ranging from 126 to 578 mg/l, and sodium ranging from 30 to 97 mg/l (Powell and Mutz 1958), and relatively high (630 mg/l) concentrations of bicarbonate in Soda Lake and fluoride concentrations in San Luis Lake as high as 3.2 mg/l. These conditions are natural for the area and cannot be attributed to anthropogenic contamination. Total dissolved solids (a measure of the combined content of all inorganic and organic substances contained in water) values of less than 500 mg/l are generally found on the Baca Refuge (FWS 2011b) except in wells deeper than about 2,500 feet, where total dissolved solids can be higher than 3,000 mg/l. The Groundwater Atlas of the United States (Robson and Banta 1995) says that Total Dissolved Solids are less than 500 mg/l along the fringes of the basin but more than 3,000 mg/l in the center of the basin. Mayo reports total dissolved solids as high as 35,000 mg/l in the unconfined aquifer south of the sump as a result of mineral dissolution, ion exchange, and methanogenesis (formation of methane) from organic and evaporate lake sediments (Mayo 2006).

The ground water in the San Luis Valley has bacteria, toxic metals, and nitrate (FWS 2011b). USGS, in an agricultural land use study, found 11 of 35 wells contained nitrate concentrations ranging from 0.1 to 58 mg/l, which is above EPA maximum contamination levels (Levings et al. 1998). Elevated nitrite and nitrate are a result of leaching of fertilizers from the land surface (Anderholm 1993). Trace amounts of pesticides were found in nearly 15 percent of the samples, but in concentrations below EPA health advisories.

Water quality concerns on the Baca Refuge include iron bacteria and manganese deposits that clog well infrastructure, including well-screens, discharge lines, and pumps. Some areas of the unconfined aquifer yield water with naturally high salinity. Ground water that reaches the Baca Refuge from septic leach fields in the Grants section of the Baca Grande subdivision is a concern.

Siebenthal catalogued an area in which gas is mingled with water in the deeper wells, described as a trough of the valley stretching from a point 4 miles northeast of Alamosa, Colorado, within 3 miles of Moffat, Colorado, with a length of 30 miles and an average width of 8 miles that includes parts of the Baca Refuge (Siebenthal 1910). Ground water from these wells is deeply tainted, containing from 42 to 134 parts per million (ppm) organic matter. Streams flowing away from these wells are bordered by alkali incrustation, and reports of the harmful effects of these waters for irrigation vary widely. Moderate use is likely to cause the formation of a hard crust on the soil surface, and its continued use in subirrigation will impregnate the soil with alkali. As distinct as the water and gas occurrence is in this trough, Siebenthal presents evidence for the continuity of the gas-bearing aquifers to the regional ground water aquifers boasting high quality ground water (Siebenthal 1910). During baseline sampling in 2008 for the Baca Refuge's environmental assessment for proposed oil and gas exploration, analysis of ground water samples detected methane in 17 of 20 wells and ethane in 10 of 20 wells (FWS 2011b), verifying the gas-bearing aquifers in the Siebenthal study.

The environmental assessment for the Baca Grande Water and Sanitation District (Brown and Caldwell 2009) found elevated nitrates in the Motel well, which is used as a water source for the Casita Park area of the subdivision near the Baca Refuge. The source of the nitrates is speculated to be either the Casita Park Waste Water Treatment Facility or the White Eagle Inn individual sewage disposal system.

Anderholm concludes that on the basis of areal distribution and range of trace element concentrations, human activities have not caused widespread contamination of the ground water. The main factors affecting trace element concentrations in the ground water are the solubility equilibrium, variation in the distribution of minerals in the aquifer, formation of organic complexes, formation of carbonate complexes, and the oxidation-reduction state of the aquifer. Relatively few synthetic organic compounds were detected, further indicating that human activities have not resulted in widespread contamination of the shallow aquifer system (Anderholm 1993).

Visual Resources and Night Skies

The National Environmental Policy Act requires that measures be taken to "assure for all Americans… aesthetically pleasing surroundings." Visual resources are those qualities of the resource that often inspire people and contribute to their overall experience or quality of life.

The Baca Refuge, which is located at an elevation of about 7,600 feet, has a moderate to high scenic quality, although areas near the Closed Basin Project are less scenic than the wet meadows and shrublands on the eastern side of the refuge. Expansive wet meadows, playas, sand sheets, and greasewood and shrubland communities are juxtaposed against dramatic views of the Great Sand Dunes as well as of the Sangre de Cristo Range, including Challenger Point, Kit Carson Peak, Crestone Peak, and Crestone Needle, which are 14,000-foot-high peaks. Abundant wildlife on the refuge contributes to the scenic qualities of the area.

The Alamosa and Monte Vista Refuges are adjacent to the towns of Alamosa and Monte Vista, but still have a rural atmosphere. As with the Baca Refuge, the scenic qualities of these refuges are high. Blanca Peak, Little Bear Peak, Ellingwood Point, and Culebra Peak, which are 14,000-foot-high peaks of the Sangre de Cristo Range, provide a spectacular backdrop for the wetlands and the shrublands of the Alamosa Refuge. The Rio Grande meanders along the western edge of the refuge, and the Bluff Overlook provides an excellent view of the refuge. Toward the western side of the San Luis Valley, the Monte Vista Refuge lies closer to the San Juan Range, where Bennett Peak rises to more than 13,000 feet and reigns over the refuge's wetlands and shrublands.

Visitor and operational facilities, roads, and smoke from wildfires or prescribed fires are some of the factors that may affect the scenic qualities of the refuges.

Another important part of visual quality is ambient light and its effect on the night sky (NPS 2007). The Baca Grande subdivision next to the Baca Refuge has developed guidelines to reduce light pollution by use of motion-activated lights as well as shielded or hooded exterior lighting that is limited to entry walks, porches, and exterior patios (Baca Grande Properties Owners Association 2012). With the limited commercial development in the area; the predominantly agricultural landscape; the clean, dry mountain air; and the large swath of public land immediately adjacent to the refuge boundary and the national park, the night skies in and around the Baca Refuge are largely dark, which provides outstanding opportunities to see the stars, moon, planets, and other celestial objects on clear nights. Preserving the view of the night sky is important for local residents.

Soundscapes (Acoustical Environment)

Except for small areas next to the refuges, the baseline soundscape is expected to be natural sounds. Localized exceptions include noises located along roads, the railroad track near the Alamosa Refuge, and trails. Noise sources include on-road and off-road vehicles, equipment, airplanes, and rail traffic. Other noise sources in the adjacent area include agricultural activity, State highways, and small airports in Alamosa and Monte Vista.

Noise

Noise is typically defined as disruptive or unwanted sound. Noise has the potential to interrupt ongoing activities and result in community annoyance, especially in residential areas. Most noticeably, annoyance occurs when noise interferes significantly with activities such as sleeping, talking, and listening to the television, radio, or music. Noise can also disrupt wildlife by changing or intruding on the natural soundscape and masking natural sounds.

Environmental noise is typically a collection of distant noise sources that result in a low-level background noise from which no individual noise source is prevalent or identifiable. The background, or ambient, noise remains relatively constant from moment to moment; however, if the area is inhabited, it may vary from hour to hour as changes in human activity patterns occur. Loud, relatively brief noise from identifiable sources such as aircraft flyovers, screeching of brakes, and other short-term events will cause the noise level to fluctuate distinctively from moment to moment.

Brief definitions of noise terminology used in this analysis are listed below (FWS 2011b).

- The receiver is the location at which the sound level is being measured or where the sound would be heard.
- A sensitive receptor is a location where people are subject to sleep or concentration disturbance.
- A decibel (dB) is the expression for sound that describes its energy level.
- A-weighted decibel (dBA) is a weighted sound level that represents how the human ear responds to normal sounds.
- Equivalent energy noise level (Leq) is the equivalent continuous noise level, usually measured over 1 hour.
- The day-night level (Ldn) is a 24-hour average Leq with a 10 dBA "penalty" added to noise during the hours of 10:00 p.m. to 7:00 a.m. to account for the greater sensitivity to noise that people have at night.
- Community noise equivalent level (CNEL) is a 24-hour average with a 5 dBA penalty added to noise during the evening from 7:00 p.m. to 10:00 p.m. and a 10 dBA penalty added during the nighttime from 10:00 p.m. to 7:00 a.m. The CNEL is similar to the Ldn, with the CNEL about 0.2 to 1 decibel greater than the Ldn.

- Sound exposure limit (SEL) is the cumulative noise exposure at a receiver from a single noise event.

Community noise environments are typically represented by noise levels measured throughout the day and night, or over a 24-hour period (CNEL); the 1-hour period is especially useful for characterizing noise caused by short-term events such as operation of construction equipment or concert noise (with Leq).

Community noise levels are generally perceived as quiet when the CNEL is below 45 dBA, moderate when it is between 45 to 60 dBA, and loud when it is above 60 dBA. Noisy urban residential areas are usually around 70 dBA CNEL. Along major thoroughfares, roadside noise levels are typically between 65 and 75 dBA CNEL. Noise levels above 45 dBA at night can disrupt sleep, and levels greater than 85 dBA can cause temporary or permanent hearing loss. When evaluating changes in 24-hour community noise levels, a difference of 3 dBA is a barely perceptible increase to most people, a 5 dBA increase is readily noticeable, while a difference of 10 dBA would be perceived as a doubling of loudness. Table 10 lists dBA noise levels for common events in the environment and industry (FWS 2011b).

Table 10. Typical A-weighted sound levels.

Sound source	*dBA reading*
Air raid siren at 50 feet (threshold of pain)	120
On platform by passing subway train	100
On sidewalk by passing heavy truck or bus	90
On sidewalk by typical highway	80
On sidewalk by passing automobiles with mufflers	70
Typical urban area background/busy office	60
Typical suburban area background	50
Quiet suburban area at night	40
Typical rural area at night	30
Broadcasting studio	20
Threshold of hearing without damage	0

Source: Cowan 1994

Noise levels diminish as the distance from the source to the receptor increases; this is referred to as "attenuation." Other factors such as the weather, reflecting, or shielding can intensify or reduce noise levels at any given location. Noise levels may also be reduced by interrupting the "pathway" between the source and receptor. For example, a single row of buildings between the receptor and the noise source reduces the noise level by about 5 dBA. Generally, the most effective way to reduce noise is through the use of a physical separation, or buffer, between the source and receptor.

Vibration

Ground-borne vibration is a back-and-forth motion that can be described in terms of the displacement, velocity, or acceleration of the motion. Activities such as construction (especially blasting and pile-driving), buses on rough roads, and trains can result in ground-borne vibration. Annoyance from vibration can occur when the vibration is only slightly noticeable and is well below the damage threshold for normal buildings. To avoid confusion with sound decibels, the abbreviation VdB is used for vibration decibels.

Typical background vibration levels in residential areas are usually less than 50 VdB, well below the threshold of perception for most humans, which is 65 VdB. Internal sources of perceptible vibration levels inside homes are attributed to the operation of heating and air conditioning systems, door slams, and foot traffic. Construction activities, train operations, and street traffic are some of the most common external sources of vibration that can be perceptible inside homes. Although perceptible at 65 VdB, typically vibration is not considered significant until it exceeds 70 VdB. Construction activities generate vibration levels between 50 and 81 VdB at a distance of 50 feet from the source. Large bulldozers can generate vibration levels at 87 VdB at 25 feet from the source. Table 11 shows the typical human response to different levels of ground-borne vibration (FWS 2011b).

Table 11. Human response to different levels of ground-borne vibration.

Vibration velocity Level (VdB)	*Response*
65	Approximate threshold of perception for many humans.
75	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find transit vibration at this level annoying.
85	Vibration acceptable only if there are an infrequent number of events per day.

Source: U.S. Department of Transportation. Federal Transit Administration 2006; FWS 2011b

Existing Noise and Vibration Sources

A noise survey has not been conducted for the refuge complex (FWS 2011b). Except for localized areas, the baseline soundscape is expected to be natural sounds. Localized exceptions to the baseline soundscape include linear noise sources located along roads, railroad tracks, and trails. These include on-road and off-road vehicles, construction equipment, planes, and rail traffic. Other existing noise sources in the San Luis Valley include agricultural activity, State highways, a local commercial airport, and freight railroads.

Existing vibration sources consist primarily of vehicular traffic, rail traffic, and intermittent construction activities. When vehicular traffic does cause perceptible vibration, the source can usually be traced to potholes, wide expansion joints, or other "bumps" in the roadway surface. Vibration from rail transit systems is usually one to two orders of magnitude below the most restrictive thresholds for preventing building damage.

Sensitive Receptors

The noise sensitivity associated with land uses determines the noise exposure goals for these various land use types. Places where people may be subject to sleep or concentration disturbance, such as homes, hospitals, guest lodging, schools, places of worship, and libraries, are more sensitive to noise than manufacturing or commercial areas. Therefore, noise exposure targets for these land use types are more stringent.

The refuges are located in a setting that can be characterized as rural, where ambient noise levels can range from 15 to 45 dBA. Noise sensitive receptors near the refuges include rural houses, low-density residential clusters, schools, places of worship, and libraries. The wilderness areas in the San Luis Valley, while not specifically considered sensitive receptors, are naturally quiet environments that are set aside for the preservation of nature and wildlife. An acoustic monitoring system deployed at Great Sand Dunes National Park and Preserve's Alpine Camp in 2009 recorded a daytime natural ambient sound level of 17.0 dBA and a nighttime natural ambient sound level of 8.7 dBA (Turina 2010). These are some of the quietest sound levels ever recorded in the National Park System.

Animal response to noise depends on many variables, including characteristics of the noise, duration of the noise, life history characteristics of the species, habitat type, season, current activity of the animal, sex, age, and earlier exposure. Loud noises do have the potential to influence wildlife activity patterns. Wildlife may temporarily avoid otherwise suitable habitat in response to noise or have reduced breeding success if a species relies on sound to secure a mate.

4.3 Biological Resources

The following section describes the biological resources that may be affected by implementation of the various alternatives. Biological characteristics include vegetation communities (typically referred to as habitats) and wildlife, including birds, large mammals, small mammals, fish, amphibians, reptiles, and threatened and endangered species as well as species of concern.

Habitat is the specific environment or ecological conditions where a species or population lives, and which provides food, cover, and other resources necessary for survival. It consists of biotic variables such as vegetation as well as abiotic variables such as soil and water.

Habitat and Wildlife

Across the refuge complex, the diversity of vegetation, soils, and hydrologic conditions provide numerous habitat types for a wide array of wildlife species. Some species are generalists, while others need a specific combination of resources. In this section, a discussion of the refuge complex's habitats is organized into three broad categories of vegetation classes: riparian areas, wetlands, and uplands (figures 43, 44, and 45).

Riparian Habitat

Riparian habitats are plant communities that are contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent rivers, streams, or drainage ways. Although riparian habitat occupies less than 1 percent of the land area in the western United States, it is disproportionately important for wildlife in general and birds in particular (Pase and Layser 1977; Thomas et al. 1979; Szaro 1980; Krueper 1993; Ohmart 1994). Vegetation associated with streams has been referred to as the "aorta of an ecosystem" (Wilson 1979) because of its significance to water, fish, wildlife, rangeland, and forest resources, and it is believed by many that the riparian ecosystem is the single most productive type of wildlife habitat and supports the greatest number of species (Ames 1977, Hubbard 1977, Patton 1977).

In the Southwest, riparian habitats support a higher diversity of breeding birds than all other western habitats combined (Anderson and Ohmart 1977; Johnson et al. 1977; Johnson and Haight 1985; Rosenberg et al. 1991; Skagen et al. 1998). For example, 82 percent of all species that breed in northern Colorado occur in riparian vegetation (Knopf 1985).

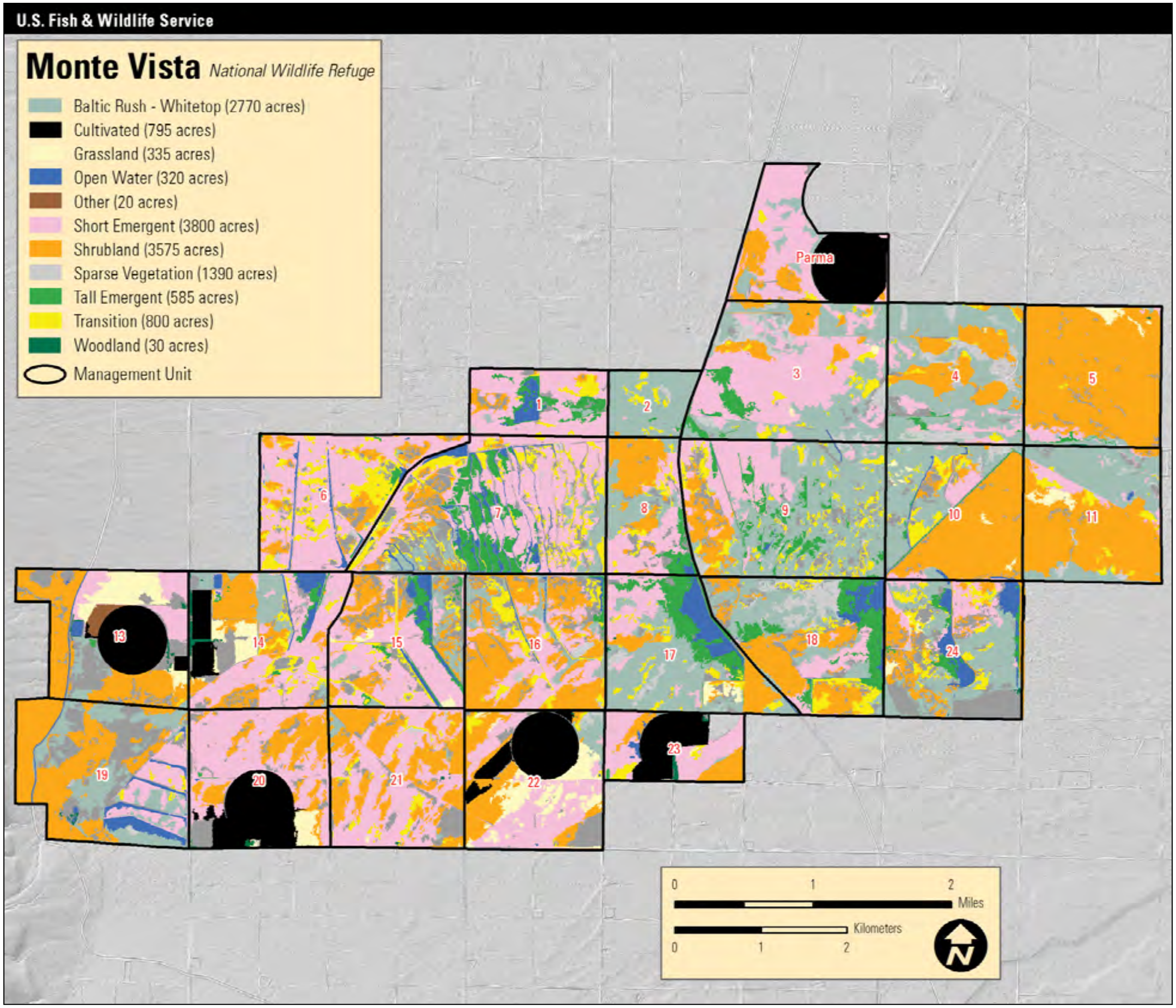

Figure 43. Vegetation classes for Monte Vista National Wildlife Refuge, Colorado.

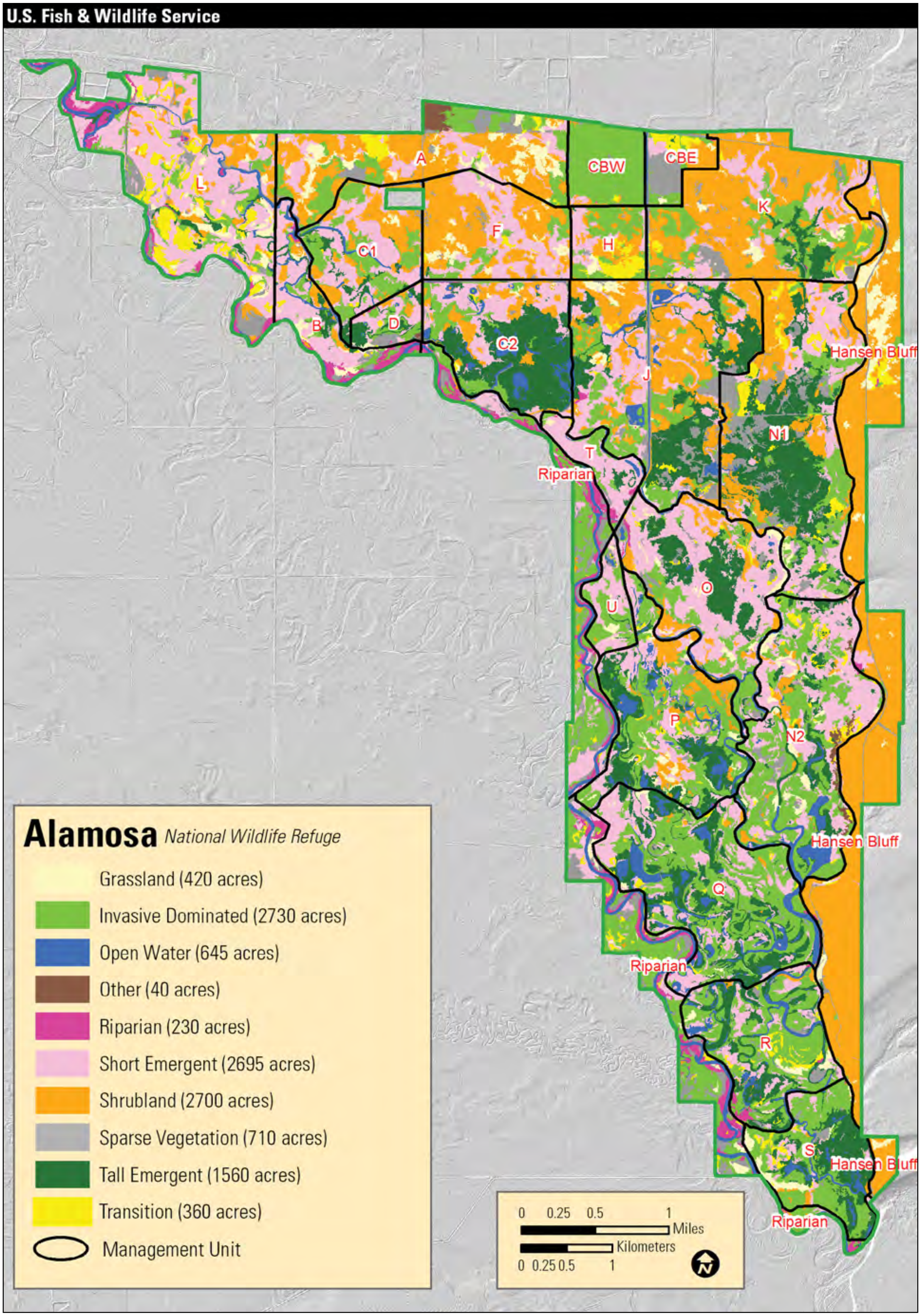

Figure 44. Vegetation classes for Alamosa National Wildlife Refuge, Colorado.

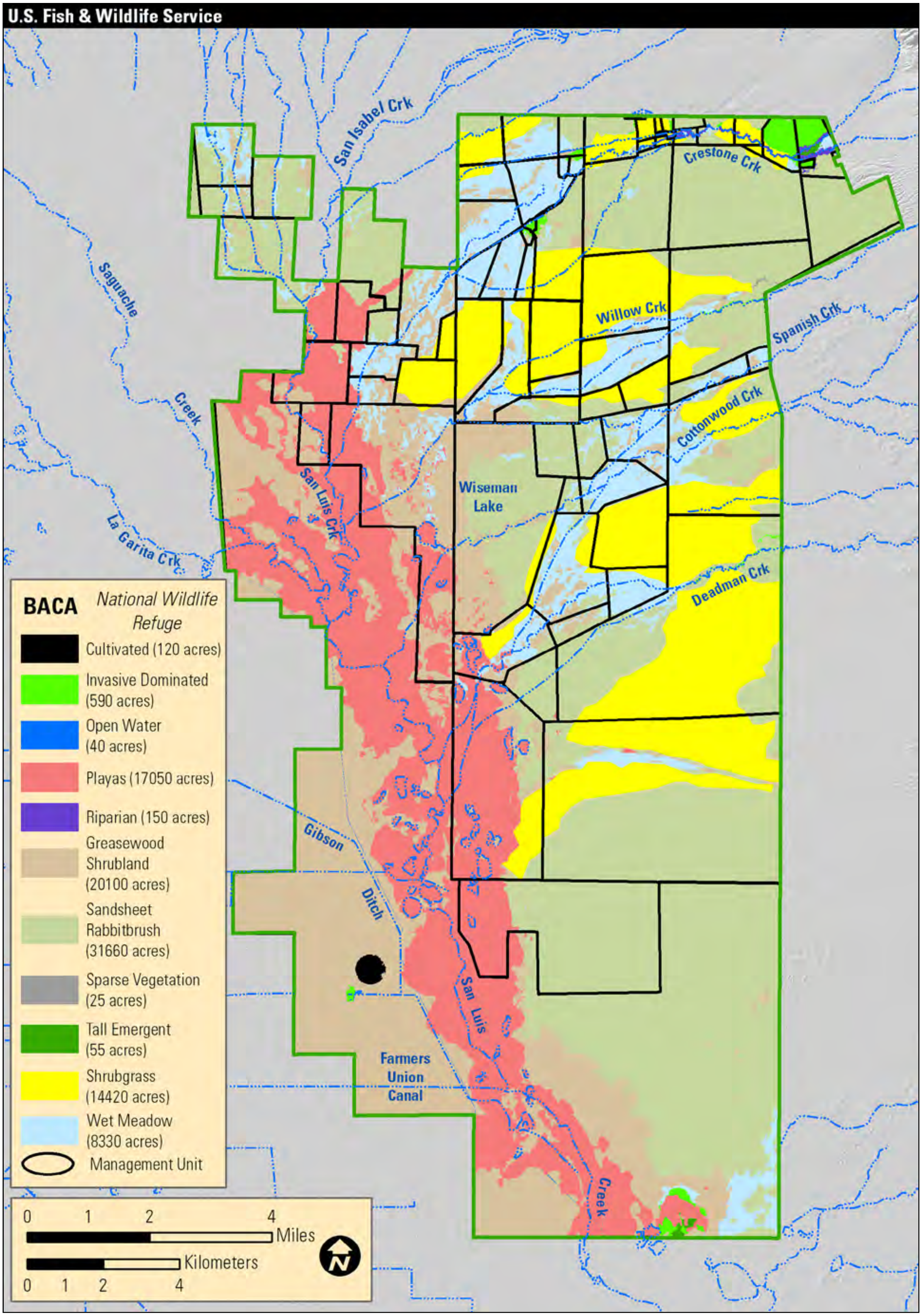

Figure 45. Vegetation classes for Baca National Wildlife Refuge, Colorado.

Johnson et al. (1977) reported that more than 75 percent of southwestern bird species nest primarily in riparian habitats, and 60 percent of them are neotropical migrants. Not only is there a high diversity of breeding bird species, but the highest non-colonial avian breeding bird densities in North America have been reported from southwestern riparian habitats (Carothers and Johnson 1975; Krueper 1993).

Healthy riparian habitats are not only crucial for breeding birds, but they attract a large number and variety of bird species during migration. More than 60 percent of all neotropical migratory birds use riparian habitat in the Southwest during migration, and these habitats have recorded up to 10 times the number of migrants per hectare than adjacent non-riparian habitats (Stevens et al. 1977, Hehnke and Stone 1979). Because of their high rates of metabolism, birds are extremely dependent on the habitats in which they find themselves during the migratory period, and must use seasonally abundant resources when available (Sprunt 1975). Southwestern riparian systems provide rich food resources during the crucial migratory period because plant growth rates and resultant vegetative biomass are high, which allows for greater insect production. In the San Luis Valley, the Rio Grande may be especially important for migrating songbirds. Because of its north-south orientation and the availability of food, water, and cover, this major arid land river may influence the survival and guide the migration of landbirds (Ligon 1961, Stevens et al. 1977, Wauer 1977, Finch 1991, Yong and Finch 2002).

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Riparian vegetation on Baca Refuge.

The disproportionately high value of riparian vegetation extends beyond birds to other vertebrates such as amphibians, reptiles, fish, and small mammals (Brode and Bury 1984, Cross 1985, Bury 1988).

Riparian plant communities are integral to stream function and aquatic productivity (National Research Council 2002). For example, in low-order streams, riparian vegetation strongly influences stream temperature, channel form, and habitats of aquatic invertebrates (Sullivan et al. 2004). Riparian plant communities are also the predominant sources of nutrients and carbon to the aquatic ecosystem through allocthonous inputs (Cummins 1974). Vegetation protects streambank soils through root strength, deflection, and dissipation of stream flow energy. Acting as a roughness element, vegetation enhances sediment, debris, and nutrient retention, and hence, channel and floodplain formation (Meehan et al. 1977; Elmore and Beschta 1987; Gregory et al. 1991). Riparian vegetation also increases channel diversity and aquatic habitats through creation of overhanging banks and coarse wood inputs (Montgomery et al. 1996; Abbe and Montgomery 1996).

There is riparian habitat on the Baca and Alamosa Refuges. There is no riparian habitat on the Monte Vista Refuge so it is not discussed in this section.

Riparian Habitat on the Baca Refuge

There are several factors, both historical and ongoing, that have inhibited the growth and regeneration of riparian vegetation on the Baca Refuge: cattle grazing that has damaged streambeds, haying that has artificially restricted the natural spread of riparian vegetation, changes in hydrology that have reduced streamflows, and elk browsing that now prevents the riparian trees and shrubs from reaching their full size.

Before the establishment of the Baca Refuge in 2004, the property was a private cattle ranch with more than 100 years of livestock grazing. It is believed that this history of grazing by domestic cattle played a significant role in the current poor condition of the riparian habitats. It has been well documented that livestock grazing can have negative effects on woody vegetative structure, composition, and vigor (Ames 1977; Evans and Kerbs 1977; Ryder 1980; Knopf and Cannon 1982; Taylor 1986). It is well documented throughout the West that poorly managed cattle grazing can negatively affect water quality, seasonal quantity, stream channel morphology, hydrology, riparian zone soils, instream and streambank vegetation, and aquatic and riparian wildlife (Belsky et al. 1999). Livestock grazing can also lead to changes in stream channel morphology and function, sediment inputs, channel incision, and streambank instability (Gunderson 1968, Behnke and

Raleigh 1978). As a result of a decline in habitat quality, declines in diversity and abundance of birds typically occurs (Mosconi and Hutto 1982, Taylor 1986, Bock et al. 1993).

Prior haying practices have also prevented the expansion and regeneration of the riparian plant community on the Baca Refuge. Many decades of large-scale haying practices have limited the distribution of various willow species because of the annual cutting of new sprouts that have encroached into the hay meadows. Since haying practices have prevented regeneration and restricted the distribution of willows, they have also likely contributed to the decline of riparian plant communities on the Baca Refuge.

Changes in hydrology that have occurred in the San Luis Valley have also affected the health of the riparian systems on the Baca Refuge. The inconsistent and irregular patterns of water availability during drought years have also lowered water tables. Willow and cottonwood trees can become stressed and die during drought years when water availability is limited. Multiple years of inconsistent water availability for these plants can be detrimental to their survival.

Since the establishment of the Baca Refuge, although livestock grazing within the riparian habitats has ceased and a minimum 20-foot buffer from haying has been enforced, riparian vegetation has not recovered as we expected. Vegetation surveys show that willow and cottonwood seedlings are abundant on many reaches of the creeks, but other sections of the creeks are not regenerating. Willow and cottonwood surveys show that virtually 100 percent of seedlings are being intensively browsed, thereby preventing the trees from reaching full height and stature. Cattle are excluded from riparian habitats, so based on observations of elk distribution and abundance as well as information from existing large mammal exclosures, elk must be responsible for this overbrowsing.

Elk populations on the Baca Refuge have increased significantly over the last three decades. Before the mid-1980s, elk were rarely observed in that part of the San Luis Valley. There are 1,000 to 3,500 elk on the refuge during the winter and 500 to 1,000 on the refuge during the summer, and they spend a considerable amount of time in riparian habitats. It has been shown that overbrowsing of riparian vegetation by native ungulates, as with domestic cattle, can damage willow and cottonwood plant structure, reproductive output, regeneration and establishment, and plant vigor and survival (Kay and Chadde 1992; Kay 1994; Singer et al. 1994; Case and Kauffman 1997; Peinetti et al. 2001; Zeigenfuss et al. 2002; Ripple and Beschta 2004a,b). Elk browsing of willow and cottonwood seedlings has been found to

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Elk exclosure put up along one of the riparian creeks to limit elk damage.

be the primary factor now preventing the recovery of the riparian habitat on the Baca Refuge (Keigley et al. 2009).

Current Conditions

There are six creeks, North and South Crestone, Willow, Spanish, Cottonwood, and Deadman, that flow onto the Baca Refuge. (Refer to figures 39 and 45.) Riparian vegetation along these creeks consists primarily of two species of willow: coyote willow *(Salix exigua)* and peach-leaf willow *(Salix amygdaloides)*. Other tree species include greenleaf *(Salix lasiandra)* and strapleaf willow *(Salix ligulifolia)* and narrowleaf cottonwood *(Populus angustifolia)*. Other shrub species include Wood's rose *(Rosa woodsii)* and golden currant *(Ribes aureum)*. The herbaceous understory consists of various grasses, sedges, Baltic rush *(Juncus balticus)*, and forbs. The current overall condition of riparian habitats on the Baca Refuge is poor, particularly the structure and distribution of woody riparian vegetation. The Crestone Creek system has some fairly healthy patches of riparian vegetation; however, these areas are limited in extent (<0.5 mile of creek) and located next to buildings. Most of the remaining Crestone Creek system, as well as the other creeks on the refuge, have scattered mature willows and cottonwoods with some patches of small (<2 feet tall) young plants. Many reaches of these creeks are incised because of the disappearance of woody vegetation and the subsequent instability of the creek bed and banks. As a result, the width of the riparian zone and active floodplain is now limited in many areas.

Characteristic Wildlife

To date, a thorough inventory of wildlife species that use riparian habitats on the Baca Refuge has not been completed. Except for the isolated patches of willows and cottonwoods on Crestone Creek, which are a small part of the creek system on the refuge, observations by refuge staff show that riparian birds are absent on most reaches of the creeks. Documented birds include yellow warbler, common yellowthroat, American robin, and song sparrow.

As with birds, a detailed inventory of small mammals has not been completed but observations from refuge staff have shown that deer mouse, western harvest mouse, Ord's kangaroo rat, least chipmunk, and meadow vole are present, and we suspect that species such as masked shrew and montane shrew also use these habitats. Porcupines and raccoons also occur. Elk use the riparian habitats throughout the year but are most abundant during the winter months. Amphibians include chorus frog and leopard frog, and reptiles include western terrestrial garter snake and smooth green snake.

In Crestone Creek, a unique native fish community is present in areas of perennial water. This creek is host to four of the six native fish species that occur in the San Luis Valley: Rio Grande sucker (Colorado State endangered), Rio Grande chub (petitioned for listing under the Endangered Species Act in 2013), fathead minnow, and longnose dace. Of particular importance is that no non-native fish species have been found in Crestone Creek, and it is one of only two remaining aboriginal populations of Rio Grande sucker in Colorado.

Riparian Habitat on the Alamosa Refuge

Aerial photographs from 1941 of the Alamosa Refuge show that there has been little change in the extent of cottonwood and willow habitats since then (Heitmeyer and Aloia 2013a). Little information exists before this time period. Though the natural extent of the riparian habitat along the Rio Grande through the Alamosa Refuge is unknown, the distribution of sandy, seasonally hydrated soils suited for cottonwood and willow survival and growth (Cooper et al. 1999, Scott et al.1999) show that this habitat was probably once much more extensive along the Rio Grande on the Alamosa Refuge. Cottonwood (which is "alamo" in Spanish) was once prevalent in the town of Alamosa (just upstream from the Alamosa Refuge); however, the historical distribution of cottonwood galleries on the Alamosa Refuge itself was not well documented.

Before the establishment of the Alamosa Refuge in 1963, the property was privately owned and managed as a working cattle ranch. Similar to other areas along the Rio Grande in the San Luis Valley, we assume that the riparian area on the Alamosa Refuge was actively grazed by domestic livestock and that damage to woody vegetation occurred. After the refuge was established, the riparian habitat continued to be grazed by cattle, though information on stocking densities is unknown. This was done in an attempt to restrict cottonwood and willow encroachment into adjacent wetland areas in an effort to preserve the integrity of waterfowl nesting habitat. It wasn't until about 1990 when all domestic livestock grazing in the riparian corridor ceased.

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The Rio Grande meanders through the San Luis Valley.

A small herd of elk became established on the Alamosa Refuge in the late 1990s, which grew over the next decade to approximately 400 head. In 2009, data showed that elk were damaging willow growth on the Alamosa Refuge (Keigley et al. 2009). This damage, though apparently localized, is restricting willows from reaching their full height and stature.

Although past grazing by domestic livestock and current browsing by elk have damaged cottonwood and willow growth and distribution, it appears that changes to hydrology and river morphology are causing the most damage to the regeneration, growth, and survival of cottonwoods and willows (Keigley et al. 2009). Since Euro-American settlement in the San Luis Valley, many rivers including the Rio Grande as well as the unconfined and confined aquifers have been drastically altered (Siebenthal 1910; Natural Resources Committee Report 1938; Emery et al. 1973; San Luis Valley Water Conservancy District 2001). Some of the changes to the Rio Grande and its tributaries upstream of the Alamosa Refuge include straightening of reaches of the river (the most significant of which was east of the town of Monte Vista during the late 1940s and early 1950s by the U.S. Army Corps of Engineers), construction of numerous reservoirs designed to catch and store early spring runoff from snowmelt, and the construction of a minimum of 48 irrigation diversions designed to divert Rio Grande water for irrigation (San Luis Valley Water Conservancy District 2001).

Because of these changes, the hydrology and morphology of the Rio Grande through the Alamosa Refuge have been severely altered. A study of the Rio Grande found that the reach through the Alamosa Refuge is deprived of sediment from upstream because of such factors as low flows and trapping and diversion of sediment at diversion structures (San Luis Valley Water Conservancy District 2001). As a result, the reach through the Alamosa Refuge is entrenched, has poor point bar formation, and has excessively eroding banks. Because the system is sediment deficient in this reach, the river has tended to lengthen and lengthening occurs as the river seeks to increase sediment supply by eroding the channel banks (San Luis Valley Water Conservancy District 2001). This is evident by the high, steep banks that are present today.

Current Conditions

Riparian habitat on the Alamosa Refuge is mostly restricted to approximately 229 acres in a fairly narrow section along the Rio Grande. Riparian vegetation consists primarily of coyote willow, peach-leaf willow, and Goodding willow *(Salix gooddingii)* as well as narrowleaf cottonwood. Other shrub species include Wood's rose and golden currant. The herbaceous understory consists of various grasses, sedges, Baltic rush, and forbs.

Although there are small patches of less than 2 acres that appear fairly healthy, most of the riparian habitat on the Alamosa Refuge is considered marginal at best. Narrowleaf cottonwoods are a small component of the woody vegetative community, with only a few patches containing this overstory species. Goodding willow, another overstory species, has individual plants scattered throughout the riparian corridor and is the least abundant species of woody vegetation. Peach-leaf willow, while abundant in a handful of patches, is primarily represented by scattered individuals or small groups of plants throughout the riparian corridor. The most abundant and widespread species of woody vegetation is coyote willow, which can be found in varying densities throughout the riparian corridor. In many parts of the riparian corridor, coyote willow is restricted to narrow (<3 meter) patches immediately adjacent to the waterline of the Rio Grande. In general, the width of the riparian habitat on the Alamosa Refuge is less than 20 meters and is considered in moderate to poor health because of various factors such as hydrology and browsing.

Characteristic Wildlife

Observations by refuge staff and sporadic surveys have documented more than 80 bird species using riparian habitats on the Alamosa Refuge for foraging, migration, or nesting. Primary nesting birds include red-tailed hawk, Swainson's hawk, American kestrel, northern flicker, western kingbird, western wood-pewee, American robin, yellow warbler, common yellowthroat, song sparrow, American goldfinch, Brewer's blackbird, and Bullock's oriole. Although numbers have declined in recent years, the federally endangered southwestern willow flycatcher nests in the willow habitat on the Alamosa Refuge. Small and medium-sized mammals using riparian habitats include deer mouse, meadow vole, long-tailed vole, masked shrew, western harvest mouse, least chipmunk, beaver, porcupine, and raccoon. Bat species such as Yuma myotis and little brown bat are also regularly found in riparian habitats. Large mammals include mule deer and elk. Amphibians using riparian habitats include chorus frog, leopard frog, and tiger salamander, and reptiles include the western terrestrial garter snake. Fish species found in the Rio Grande through the Alamosa Refuge include nonnative species such as common carp, white sucker, and northern pike. Native fish known to inhabit the refuge include black bullhead, fathead minnow, flathead chub, green sunfish, longnose dace, and red shiner.

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Porcupines often strip bark off willows or cottonwood trees, which can be of concern when restoring riparian areas on Alamosa Refuge.

Wetland Habitat

Wetlands are some of the most important habitats in the world, and countless animal and plant species depend on wetlands and the resources they provide. More than one-third of the United States' threatened and endangered species live only in wetlands, and nearly half use wetlands at some point in their lives.

Wetlands provide breeding and foraging habitat for birds and amphibians, permanent homes for fish, and a water source for many other species. Wetlands intercept and filter sediment, nutrients, and toxic chemicals from surface water runoff before it reaches open water areas or ground water.

Land use practices in the San Luis Valley have significantly changed the landscape and ecosystem. Hydrologic conditions have changed, and the dominant land uses are ranching and growing potatoes, small grains, and alfalfa. Natural flow regimes in creeks and rivers have been significantly altered and, in some cases, depleted entirely.

For example, Spring Creek, which originates from a natural spring on the western part of the Monte Vista Refuge, ceased flowing in the early 1970s as the spring dried up and has not flowed since. Rock Creek, which is fed by mountain snowmelt, once created the largest natural wetland complex on the refuge. Rock Creek has had its water diverted for irrigation of agricultural lands at upper reaches, has been obstructed by roads and canals, and has had its channel completely obliterated west of the refuge. As a consequence, there are no natural flows onto the refuge from Rock Creek (figure 46).

The Baca Refuge has experienced similar events. Much of the water that had historically created the roughly 17,049 acres of playa and associated 8,329 acres of short-emergent habitat and that had contributed substantially to ground water levels entered from the west side of the refuge from snowmelt-fed streams, including Saguache, La Garita, and San Luis Creek with all its tributaries north of the refuge (figure 39). As with many other stream systems in the San Luis Valley, during most years all the water in these creeks is diverted for agricultural purposes. Ground water pumping of the unconfined aquifer within the closed basin of the San Luis Valley has resulted in a lowered water table, which dramatically influences surface flows. The result is that surface flows have not reached the refuge boundary from the west since the late 1980s.

On the Alamosa Refuge, hydrologic conditions have also changed. Even though the Rio Grande still flows along the western boundary of the refuge, flows have been severely altered to the extent that at times the lowest annual flows through this reach occur during the periods when the highest annual flows used to occur. Even during the years when annual high flows do occur during the typical period of peak snowmelt runoff (late spring to mid-summer), that peak has substantially diminished due, in large part, to the diversion of water upstream for the irrigation of agricultural lands. (Refer to water resources, section 4.2 above.)

Historical Water Use on the Refuges

Before the establishment of the refuges, all three were privately owned cattle ranches focused on livestock grazing and hay production.

Because hydrologic changes have drastically reduced or eliminated natural stream flows entering the refuges, surface hydrologic inputs are dependent on diverted surface irrigation water from the Rio Grande (Monte Vista and Alamosa Refuges) and smaller creeks originating in the Sangre de Cristo Mountains (Baca Refuge) as well as from pumped ground water. Water management infrastructure, including irrigation ditches and canals, levees, and water diversion and control structures, has precipitated changes in land use and vegetation type (figures 43, 44, and 45). Water diversion and irrigation in the valley have resulted in a drastic change in habitat types in many areas. For example, by controlling the timing and depth of water, native shrub habitats have been converted to and managed as semipermanent or permanent wetlands.

Current Conditions

The refuge complex supports a diversity of wetland types (figures 43, 44, and 45), including temporary or ephemeral wetlands interspersed with native shrublands, semipermanent wetlands such as oxbows along the Rio Grande, and created wetlands. Collectively, these wetland areas support a range of primary habitats, including open water; bare mudflats; short-emergent; tall-emergent; transition (dominated by saltgrass), and other vegetative communities associated with the primary wetland habitat types described earlier.

Short-emergent habitat is the most abundant wetland type on the refuge complex, with an area of about 20,753 acres, of which 5,426 acres are on the Alamosa Refuge, 6,998 acres are on the Monte Vista Refuge, and 8,329 acres are on the Baca Refuge. This habitat type, also referred to as wet meadow, is characterized by grasses and grass-like plants and is seasonally and shallowly flooded. The dominant species in this habitat are cool-season plants that require water early in the growing season. Most of the short-emergent habitat on these refuges is dominated by a dense growth of Baltic rush, although other species are also abundant, such as spike rush, alkali muhly, curly dock, *Calamagrostis*, foxtail barley, short-awn foxtail, awned sedge, woolly sedge, short-beaked sedge, and beaked sedge. Invasive weeds such as

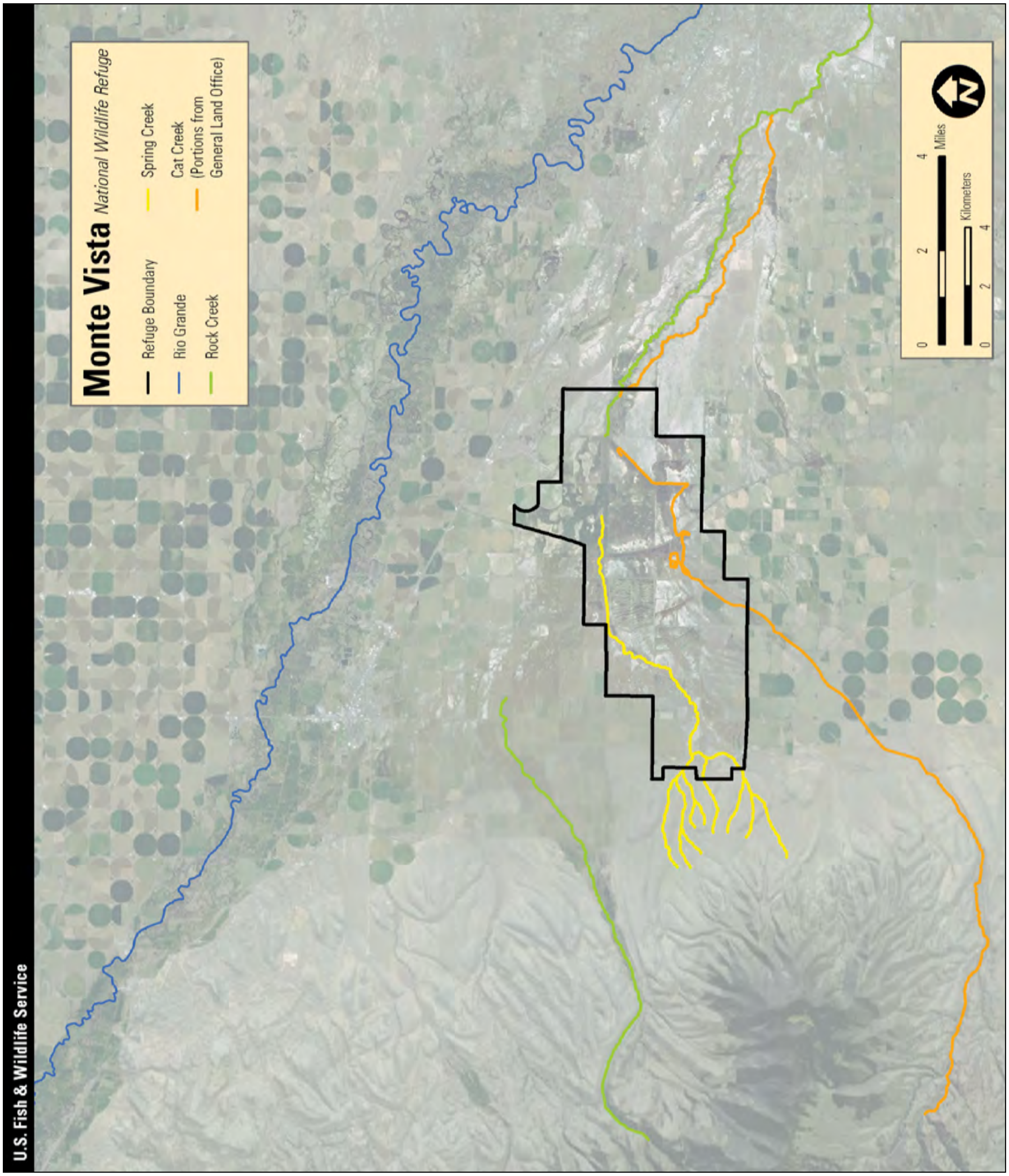

Figure 46. Location of historical creeks flowing into and through Monte Vista National Wildlife Refuge, Colorado.

Canada thistle *(Cirsium arvense)* and tall whitetop *(Lepidium latifolium)* are present in some areas.

Tall-emergent habitat, which covers 1,561 acres on the Alamosa Refuge, 599 acres on the Monte Vista Refuge, and 54 acres on the Baca Refuge, is associated with water that is usually more than 15 inches deep and is semipermanent to permanent. Cattails, hardstem bulrush, and phragmites (on the Alamosa Refuge) dominate these deeper water areas. This vegetative community is typically found lining edges of ponds, levees, and canals, or as large contiguous patches or islands in areas of open water.

Transition habitat (called shrub–grass on the Baca Refuge) is usually associated with alkali soils in a variety of hydrologic conditions and is dominated by salt-tolerant grass species such as inland saltgrass, alkali sacaton, alkali muhly, and alkali grass. It can contain scattered black greasewood and rabbitbrush plants. When higher soil moisture occurs, large amounts of slender spiderflower appear. Typically, this is a seasonal wetland habitat type flooded only for short durations (< 60 days) in the spring with shallow water (< 3 inches).

Characteristic Wildlife

Wetlands in the San Luis Valley, particularly those found on the refuge complex, are vitally important to birds because they provide foraging, resting, and breeding habitat. More than 100 bird species have been documented using the wetland habitats on the refuge complex. At least 11 species of waterfowl nest on the refuges: Canada goose, mallard, gadwall, blue-winged teal, cinnamon teal, green-winged teal, northern shoveler, northern pintail, redhead, American wigeon, and ruddy duck. Many shorebirds use refuge wetlands, especially short-emergent and transition habitats, for foraging and nesting. American avocet, black-necked stilt, Wilson's phalarope, Wilson's snipe, killdeer, and spotted sandpiper have been documented nesting on the refuge complex. The largest colony of nesting white-faced ibis in Colorado uses some of the tall emergent habitats on the refuge, as do snowy egret and black-crowned night-heron. Species such as American bittern, sora, and Virginia rail also nest and forage in refuge wetland habitats. Common yellowthroat, yellow-headed blackbird, red-winged blackbird, western meadowlark, marsh wren, Savannah sparrow, and vesper sparrow can be found foraging and nesting in the wetland habitats found on the refuges. About 95 percent of the Rocky Mountain population of greater sandhill cranes spends several weeks in the San Luis Valley during spring and fall migration, feeding and roosting in shallow water wetlands, primarily on the Monte Vista Refuge.

Many species of mammals use the refuge wetlands, including elk, deer, coyote, muskrat,weasel, deer mouse, and meadow vole. The San Luis Valley is a cold mountain desert and, as such, supports a limited number of amphibians and reptiles; however, tiger salamander, chorus frog, leopard frog, Woodhouse's toad, Plains spadefoot toad, Great Plains toad, and western terrestrial garter snake are common on the refuges.

Playa Habitat

Playa wetlands are shallow, typically round, ephemeral bodies of water with clay floors that lie in the lowest point of a closed watershed. In the San Luis Valley, playa systems are found in the closed basin and have formed in the terminal reaches of streams that originate in the nearby mountain ranges (Cooper and Severn 1992). Playa formation is also influenced by the complex interactions of surface and ground water (Riley 2001). The playa habitat on the Baca Refuge represents just some of the playa system occurring in the San Luis Valley, which stretches from the northwestern corner of the San Luis Valley to the northern tip of the Alamosa Refuge, with the greatest concentration of playas occurring along the western boundary of the Baca Refuge (figure 45), and extending south to BLM's Blanca Wetland Habitat Area, 5 miles northeast of the Alamosa Refuge. In the San Luis Valley, playas are the rarest and one of the most valuable wetland habitat types for wildlife. The playa area is commonly referred to as the sump of the San Luis Valley (figure 47). Playas are intimately tied to snow-melt runoff patterns and the water table (Cooper 1996). Hydrologic inputs to the playas were historically provided primarily through snowmelt-fed streams during spring to mid-summer, and many playas dried up by late summer. Monsoonal rain events may have caused some playas to refill in late summer; however, these were of secondary importance. Ground water levels most likely also affected the hydrology of the playas (Cooper et al. 2000, Riley 2001). Ground water discharge into the playas may also have occurred in the closed basin during years of high precipitation when the subsurface flow was forced to the surface by the semipermeable clay layer separating the unconfined and confined aquifers. The soils in playas are alkali clays with low rates of water infiltration, which allows rapid evaporation at the water surface and subsequent accumulation of salts. As a result, they support flora and wildlife communities adapted to saline conditions and a dynamic hydrologic regime.

Historical Condition of Playas

For thousands of years, the creeks entering the San Luis Valley from the northwest, north, and east drained into this sump, creating a series of playas. (Heitmeyer and Aloia 2013b, figure 47). Reports and maps created by a U.S. Army surveyor (Wheeler

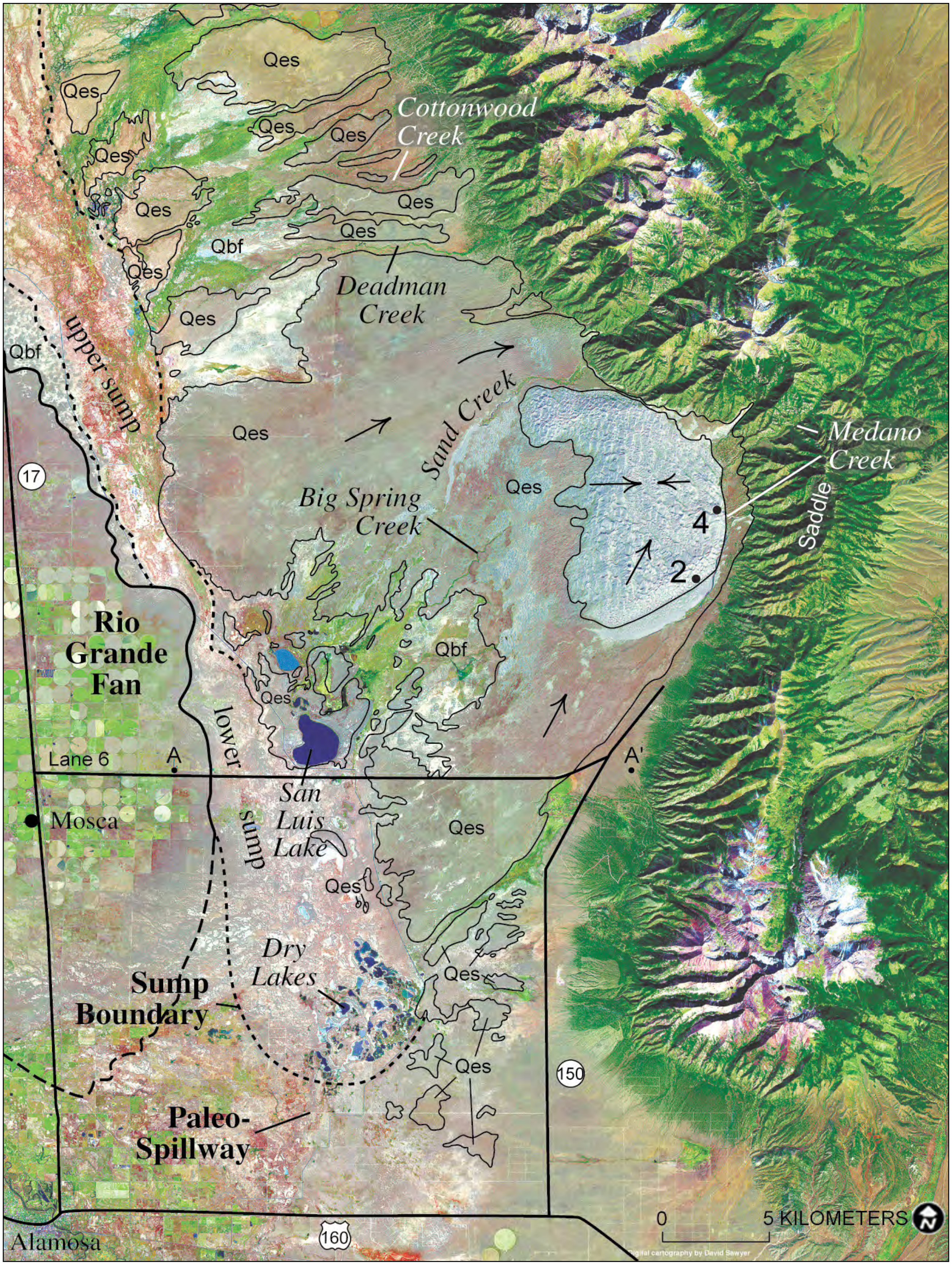

Figure 47. Location of upper and lower sump area on Baca National Wildlife Refuge, Colorado.

Source: Madole et al. 2008

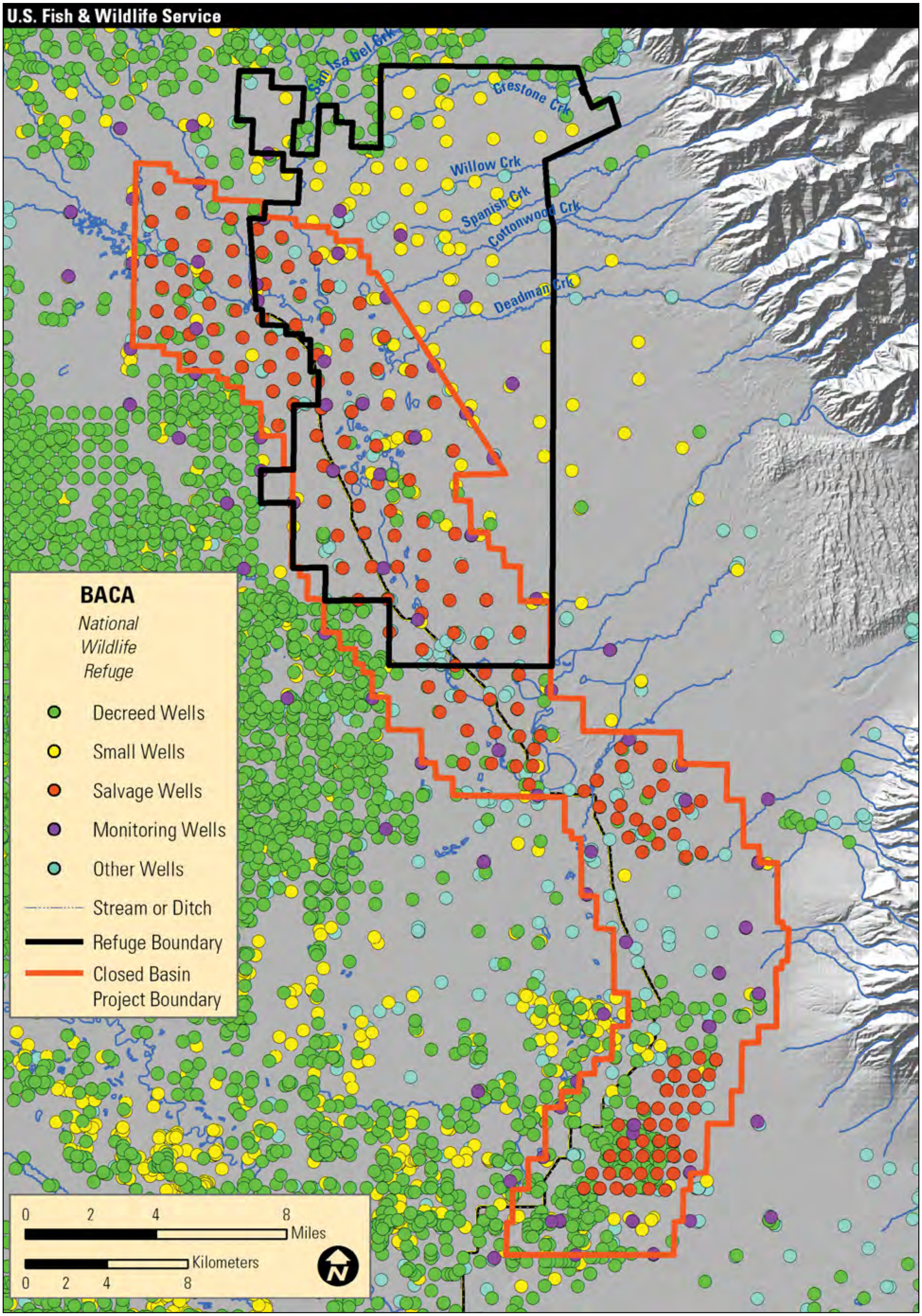

Figure 48. All wells on or adjacent to Baca National Wildlife Refuge, Colorado.

1877) show extensive marshes in the northern San Luis Valley, and Wheeler and Humphreys (1878) describe the "San Luis swamp" extending nearly 100 kilometers down the middle of the valley, including the area that is now the Baca Refuge. The primary surface water inputs to the playa system were from snowmelt-fed creeks from both the San Juan Mountains to the west and the Sangre de Cristo Mountains to the east. Historically, Saguache, La Garita, and Carnero Creeks flowing from the west most likely provided the greatest water inputs to the playa system. From the northeast, Rito Alto and San Luis Creeks as well as Crestone, Willow, Spanish, Cottonwood, and Deadman Creeks from the east provided additional surface flows to the playa system.

Playa habitat in the area has been altered more than all other wetland habitat types, including riparian habitat. The changes to the hydrology of the creeks and the unconfined aquifer have contributed immensely to the decline in the function, extent, and productivity of the playa system.

Significant diversion of water for agriculture from these creeks began toward the end of the 19th century and extended into the 20th century. Aerial photography from the 1940s (Heitmeyer and Aloia 2013b) shows that a lot of water was still reaching the playa habitat, at least during some years. The advent of large-scale ground water pumping in the mid-20th century and the start of the Closed Basin Project in the late 1980s led to the virtual elimination of functional playa habitat on the Baca Refuge and in the rest of the closed basin. Because playas depend on a complex interaction of surface and ground water sources, any land use changes that alter the timing or magnitude of surface and ground water flows are likely to detrimentally affect playas. Even minor changes in the water table depth or duration of inundation can have profound effects on soil salinity, and consequently, wetland vegetation (Cooper and Severn 1992). Although a dynamic hydrologic regime is natural and preserves the unique flora, fauna, and soil chemistry associated with playas, these prolonged, substantial perturbations to the hydrology result in severe damage to the function and productivity of playa habitats.

Current Condition

Because the playa wetlands on the Baca Refuge are usually dry, the current condition of this habitat type could be described as poor.

Mud flats may also be present in areas where soil salts are less abundant. Because most of the playa habitat on the Baca Refuge has not been inundated for approximately 20 years, many of these classic vegetation zones have disappeared and have been replaced by vegetation typical of upland habitats, such as greasewood and rubber rabbitbrush, even into the deepest playa basins. Playa basins are typically surrounded by greasewood and rabbitbrush with an understory of saltgrass. These basins have been dry more often than wet, and the result is mostly barren salt flats. Invasive Russian knapweed *(Acroptilon repens)* may be present on basin floors. Basins are productive when inundated and are capable of producing high amounts of native herbaceous biomass. Common plants in playa basins during wet years consist of saltgrass *(Distichlis stricta)*, native rushes such as Baltic rush *(Juncus balticus)*, and sedges *(Carex* spp.*)*. Patches of tall emergent plants such as bulrush *(Scirpus* spp.*)* and cattails *(Typha* spp.*)* may also be present.

Characteristic Wildlife

When playa wetlands are in good condition, they serve as important reservoirs of biodiversity (Haukos and Smith 1994). Although wildlife species such as waterfowl, passerines, and amphibians rely on functional playa habitats for nesting, brood rearing, and foraging, shorebirds are perhaps the most dependent on these saline wetlands. On the Baca Refuge, the overall poor condition of this habitat type makes it of little value for the bird guilds mentioned above. However, species that have been observed in the dry playas include upland birds such as the mourning dove, sage thrasher, loggerhead shrike, vesper sparrow, and horned lark. In recent years, when surface water from the east has been able to reach and wet some of the playas, Wilson's phalarope, black-necked stilt, American avocet, white-faced ibis, and black tern have been observed in the area. However, in recent years, as well as since refuge establishment in 2004, the playa system generally has received little to no water. Few wetland species have used these habitats for many years. If wetted, this area has the potential to support species such as killdeer, semipalmated plover, Baird's sandpiper, Wilson's snipe, greater and lesser yellowlegs, long-billed dowitcher, long-billed curlew, marbled godwit, red knot, and a variety of other shorebird species.

Functional playa habitats are extremely important for numerous species of waterfowl such as cinnamon teal, mallard, northern pintail, and gadwall. Playa basins and temporary wetlands provide resources for several amphibians to meet their lifecycle needs. Northern leopard frog, chorus frog, Great Plains toad, spadefoot toad, and tiger salamander are all found in these habitats. Lastly, highly diverse and abundant macroinvertebrate populations are found in the playa basins, with many of these surviving in a dormant cyst condition for years in the soil and emerging after a few weeks of available water in the basins.

Upland Habitat

Native upland habitat has been altered or destroyed by conversion to agriculture, livestock grazing, infrastructure development, and altered hydrologic regimes. Many of the songbird species found in the shrubland habitats on the refuges have experienced population declines throughout their ranges (Robbins et al. 1986, Askins 1993, Sauer et al. 1997). For example, according to the breeding bird survey, Brewer's sparrow populations have fallen by more than 50 percent during the past 25 years (Holmes and Johnson 2005). Species such as sage thrasher (Gebauer 2004, Sauer et al. 2004) and loggerhead shrike (Yosef and Lohrer 1995) have also experienced population declines.

Before the refuges were established, many of the management practices on all three refuges were designed to expand the area of wetland vegetation (primarily Baltic rush and other forage grasses) to promote livestock grazing and hay meadows. After the Alamosa and Monte Vista Refuges were established, maximizing waterfowl production became the primary goal. This was accomplished through the construction of water management infrastructure without considering soil type or other abiotic factors. As a consequence, many areas of native upland habitat were inundated, and hydric conditions were created on soil types that would not naturally support wetland plant growth unless substantial amounts of water were applied. In these areas, wetland vegetation can persist in these created wetlands as long as sufficient amounts of water are available.

Also before refuge establishment, areas of native upland habitat were converted to agricultural fields on both the Monte Vista and Alamosa Refuges. Since the refuges were established, many of these former farmland areas have been abandoned or attempts have been made to create artificial wetland habitat.

In areas where irrigation of upland habitats was not possible or attempted, native upland vegetation remained largely intact. Before the refuge was established, these areas provided additional land for livestock grazing. Since the refuge was established, these areas have not been intensively managed.

Current Conditions

Most upland habitats on the refuges are dominated by salt desert shrub communities, including sandsheet rabbitbrush in sandy soils and greasewood shrubland in clay soils. In sandsheet rabbitbrush, the shrub overstory is typically dominated by rubber rabbitbrush *(Ericameria nauseosa)*. Other shrub species are more uncommon but may be present, such as greasewood *(Sacrobatus vermiculatus)*, fourwing saltbush *(Atriplex canescens)*, shadscale *(Atriplex confertifolia)*, and winterfat *(Krascheninnikovia lanata)*. Native bunchgrasses occupy the understory, with the density of ground coverage heavily dependent on precipitation levels. Ground coverage of bunchgrasses can be medium to high in years with a lot of precipitation, and can be sparse to medium in years with little precipitation. Typical understory grasses include Indian ricegrass *(Oryzopsis hymenoides)*, alkali sacaton *(Sporobolus airoides)*, western wheat grass *(Pascopyrum smithii)*, needle and thread *(Hesperostipa comata)*, and blue grama *(Bouteloua gracilis)*. Native forbs are abundant in the understory during years of high precipitation. Large patches of grassland with few or no shrubs may be found within this habitat type, resulting in a grassland-shrubland complex.

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Western meadowlarks are focal birds found in native grasslands.

In greasewood shrubland, the shrub overstory is dominated by greasewood. Fourwing saltbush is present but less common. Ground cover density in the understory is typically sparser in this plant community than in the sandsheet rabbitbrush habitat type, but is denser during years of high precipitation. Inland saltgrass *(Distichlis stricta)* and other native bunchgrasses such as alkali sacaton and ring muhly *(Muhlenbergia torreyi)* occupy the understory. Sparse herbaceous vegetation and bare soil is common, especially in dry years.

Some areas where upland habitat was converted to wetlands but then was allowed to dry out are dominated by annual and perennial invasive weeds such as kochia *(Kochia scoparia)* and tall whitetop *(Lepidium latifolium)*. Similarly, on former farmland areas, current vegetation consists primarily of annual and perennial invasive weeds such as tall whitetop and Russian knapweed *(Acroptilon repens)*.

Characteristic Wildlife

Bird diversity and densities tend to be relatively low in semi-desert shrubland and other upland habitats because of structural and floristic simplicity (Wiens and Rotenberry 1981). Species common to these upland habitats are mourning dove *(Zenaida macroura)*, western meadowlark *(Sturnella neglecta)*, loggerhead shrike *(Lanius ludovicianus)*, sage thrasher *(Oreoscoptes montanus)*, and Brewer's sparrow *(Spizella breweri)*. Areas where grasses dominate have the potential to support rare grassland dependent species such as vesper sparrow *(Pooecetes gramineus)*.

Numerous mammal species use upland habitats on the refuges, including elk *(Cervus elaphus)*, pronghorn *(Antilocapra americana)*, white-tailed jackrabbit *(Lepus townsendii)*, Wyoming ground squirrel *(Spermophilus elegans)*, northern grasshopper mouse *(Onychomys leucogaster)*, northern pocket gopher *(Thomomys talpoides)*, Ord's kangaroo rat *(Dipodomys ordii)*, plains pocket mouse *(Perognathus flavescens)*, silky pocket mouse *(Perognathus flavus)*, and thirteen-lined ground squirrel *(Spermophilus tridecemlineatus)*.

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White-tailed jackrabbits are seen on the refuge complex.

Shrub-Grass Habitat on the Baca National Wildlife Refuge

This upland habitat type occurs in areas that receive high amounts of subsurface irrigation from the adjacent wet meadows (see cover types map, figure 45). Before refuge establishment, more than a century of irrigation practices resulted in artificially expanded areas of short-emergent vegetation. Meadows were expanded to promote hay production. Since the Baca Refuge was established, these wet meadows are managed to provide valuable habitat for many native species. These large wetlands have also resulted in sizeable expanses of adjacent areas that receive subsurface irrigation. The shrub-grass habitat is associated with these conditions, and vast areas of this habitat occur. Before these extensive irrigation practices, the shrub-grass plant community likely consisted of upland shrubs and grasslands because little subsurface water would have reached these areas (see potential historic vegetation map, Heitmeyer and Aloia 2013b).

Current Conditions

This habitat type is generally located between irrigated wet meadows and dry uplands on sandy and loamy soils. It combines characteristics of both adjacent habitat types. Like the uplands, it is dominated by a shrub overstory; like the wet meadows, it can have patches of dense grass in the understory.

The shrub overstory is dominated by rubber rabbitbrush. Other shrub species such as black greasewood, fourwing saltbush, and shadscale are uncommon. Shrubs in this plant community are typically taller and denser than in the sandsheet rabbitbrush upland habitat. The understory is dominated by native grasses such as alkali sacaton and inland saltgrass as well as rushes such as Baltic rush. In this plant community, the ground cover density of herbaceous vegetation is usually higher than in the adjacent uplands because of subsurface irrigation from the wet meadows. This habitat type may also contain areas with excess alkali in surface soils, and patches of barren salt flats can occur among the shrubs. The globally rare slender spiderflower occurs commonly along the periphery of this habitat. Invasive weeds are uncommon in this habitat type, but include Canada thistle, tall whitetop, and Russian knapweed.

Characteristic Wildlife

Common birds are Brewer's sparrow, vesper sparrow, western meadowlark, sage thrasher, loggerhead shrike, and mourning dove. Numerous mammals use the shrub-grass habitat, including elk, pronghorn, coyote, badger, white-tailed jackrabbit, Wyoming ground squirrel, northern grasshopper mouse, northern pocket gopher, Ord's kangaroo rat, plains pocket mouse, silky pocket mouse, deer mouse, least chipmunk, and thirteen-lined ground squirrel.

Invasive and Noxious Plant Species

Many invasive and noxious plant species have infected and degraded many of the aquatic and terrestrial habitats in the refuge complex (table 12). Some highly invasive species such as tall whitetop, phragmites, and Russian knapweed can produce monotypic stands that completely displace native and desirable plant communities. Some invasive species are also classified as noxious weeds; they can directly or indirectly injure crops, navigation, other agriculture, fish and wildlife, and public health. For the refuge complex, native communities are essential for supporting high-priority species and species groups on the refuges. Our overall strategy in managing invasive plants is to use an integrated pest management approach, which is a structured and logical approach that uses a combination of cultural, biological, mechanical, and chemical tools. Past efforts have included mapping and treating invasive species. Treatment methods for invasive weeds vary with species, daily weather conditions, plant growth stage, and time of year.

Table 12. High-priority invasive weeds found on the San Luis Valley Refuge Complex.

Common name	*Scientific name*
Canada thistle	*Cirsium arvense*
Tall whitetop or perennial pepperweed	*Lepidium latifolium*
Russian knapweed	*Acroptilon repens*
Hoary cress	*Cardaria draba*
Phragmites	*Phragmites phragmites*
Russian olive	*Elaeagnus angustifolia*
Saltcedar	*Tamarix ramosissima*
Eurasian watermilfoil	*Myriophyllum spicatum*
Swainsonpea	*Swainsona pyrophilia*
Yellow toadflax	*Linaria vulgaris*

Methods used to treat invasive species have included herbicide application, prescribed fire, grazing, biological controls, hand pulling, haying, mowing, and plowing. Along with prescribed fire, grazing, and mechanical treatments, chemical applications of herbicides have significantly aided in efforts to control the spread of invasive plant species. Chemical applications are used on specific species and applied during the optimal plant stage of growth to increase the effectiveness of the application. We only use chemicals that have been approved for use on refuges, and the application of a specific chemical onsite must undergo a pesticide use proposal (also called PUP) evaluation. The refuge complex also has partnerships with county weed districts to exchange knowledge and resources.

Typically, we use a combination of techniques to control invasive plants and achieve desirable habitat conditions. For example, we have used sheep to graze Russian knapweed infestations followed by herbicide application. We use prescribed fire to remove decadent plant material to ensure greater efficacy of chemical application on the targeted species. Mechanical treatments of Russian olive have been followed by chemical application to prevent shoots from sprouting from the stump or root system.

The plants listed in table 12 and described below are of the highest priority for the refuge complex and are part of our invasive species management efforts. Several of these are also classified as noxious weeds by the State of Colorado and are targeted for eradication or other management actions (Colorado Department of Agriculture 2013). These species represent a significant threat to the refuge's capability to meet refuge purposes and habitat management objectives, especially those related to migratory birds.

Tall Whitetop or Perennial Pepperweed

This noxious weed is a perennial forb from southeastern Europe and western Asia. It is competitive and adaptive; as a result, it has become established throughout the western United States and is a serious land management and conservation problem. This species tolerates saline soils and thrives under an array of hydrological conditions. Tall whitetop is well adapted to riparian and wetland areas and threatens native hay and forage production. In riparian zones, it interferes with regeneration of willows and cottonwoods, and in wetland areas, the composition and productivity of herbaceous species is radically changed (Young et al. 1995). This tall weed (3 to 4 feet) grows and reproduces vigorously and is capable of forming dense monocultures. Tall whitetop started becoming established in the early 1950s (Harrington 1954), and now, to varying degrees, occurs in most of the refuge complex's habitat types, but is most prevalent in short-emergent vegetation, where it can be sparse to dominant. It is found along roads, levees, and other disturbed areas. This weed decreases the quality and quantity of wildlife habitat and it is a concern to refuge neighbors and local weed boards. Therefore, control of this weed is a vital issue for habitat management on the refuge complex.

Canada Thistle

This creeping perennial is a noxious weed that reproduces from vegetative buds in its root system and from seed. Because it has an extensive root system with vast nutrient stores, it is difficult to control. It is fairly common in riparian and wet meadow areas as well as disturbed sites. The infestation of this species is similar to that of tall whitetop on the refuge complex except that thistle exists in a slightly more narrow range of hydrological conditions. Few monotypic stands of thistle occur on the complex, but it is a species of concern for refuge managers because of its degradation of habitat and because it is a large concern of the county weed boards and neighbors.

Russian Knapweed

This weed is a nonnative, herbaceous perennial that reproduces from seed and vegetative root buds. This weed forms dense, single-species stands over time because of its allelopathic capabilities and ability to outcompete native species. Russian knapweed is found throughout the west under various conditions, and in Colorado it is found on a variety of soil types. On the refuge complex, this species is found in or near agriculture fields, in disturbed areas, along roads and levees, in playa basins, and in some upland grass habitats. This weed has formed large monotypic stands only in abandoned farm fields on the Monte Vista and Alamosa Refuges and in playa basins on the Baca Refuge. Across the rest of the refuge complex, it occurs as localized patches typically less than one-quarter acre in size.

Hoary Cress

This perennial weed is abundant across the San Luis Valley. Once established in a meadow, it is a highly competitive weed that is unpalatable to most livestock and wild grazers. It has been creeping its way into pastures, fields, croplands, and meadows across most of the United States for many years. Hoary cress is native to western Asia and Eastern Europe and most likely entered the United State via contaminated alfalfa seeds in the early 1900s. The plant emerges in early spring and blooms between May and June, producing many white flowers with four petals with a flat-topped appearance. It typically grows between 0.1 to 0.5 m tall with lance shaped leaves.

Each plant can produce 1,200 to 4,500 seeds annually that can spread by wind, vehicles, and even irrigation systems, quickly saturating their surrounding areas. Buried seeds can remain viable in the soil for up to 3 years even through the harsh, freezing winters that are common in the San Luis Valley. Hoary cress does not rely only on seed dispersal for taking over the landscape. Each plant can establish an extensive lateral root system that can spread out to 30 feet within 2 to 3 years, sending off up to 50 new shoots per year from that single root structure. In general, hoary cress grows better in alkali soils with moderate amounts of moisture. Hoary cress can take over disturbed sites, including areas with extensive grazing or tilling. It is commonly found in fields, meadows, pastures, open grasslands, waste areas, roadsides, gardens, feedlots, watercourses, and riparian habitats, and along irrigation ditches. Hoary cress has the ability to spread quickly and crowd out native plants. Within two to three years of entering an area, it can become a monoculture. Grazing, irrigation, and cultivation, all of which are common practices in the San Luis Valley, can promote the spread of hoary cress. It is an extremely persistent noxious weed on many areas of the refuge complex.

Phragmites

Also known as common reed, it is a large, coarse, perennial grass often found in wetlands. Although scattered clumps of phragmites provide cover for small mammals and birds, it usually forms large, dense stands that provide little value for wildlife. Phragmites reduces the diversity of plant and wildlife species. It is found in wetlands worldwide. It grows in wet areas including fresh or brackish marshes, creeks, the edges of ponds and lakes, and ditches. Dense stands of phragmites usually are associated with areas where soil has been exposed or disturbed. The plants are less competitive when water levels vary by seasons and years. Phragmites has a thick stalk that can reach 13 feet in height. It has a large plume-like inflorescence that persists throughout the winter. Phragmites most often spreads by creeping rhizomes. All stands of phragmites have vertical and horizontal rhizomes, and young stands have long surface runners that help to rapidly expand the colony.

Phragmites occurs on the Alamosa Refuge, where there are extensive and monotypic stands that extend along the eastern side of the refuge from the middle (near the Mumm Well) to the southern end. These stands have replaced approximately 600 acres of marsh and wet meadow vegetation that would otherwise be occupied primarily by cattail, bulrush, Baltic rush, and sedges.

Eurasian Watermilfoil

This species is native to Northern Europe and Asia. Eurasian watermilfoil spreads most commonly by stem fragmentation and runners. The plant roots on the bottom, but survives and is spread as free floating plants waiting to take root. Eurasian watermilfoil also spreads by seeds. The leaves each have 12 to 21 pairs of leaflets and are 1 inch long. The plant is typically submersed with stems to 4 m long, becoming emerged only while flowering or after stream or canal drawdown when moisture is present. The flowers occur from June to September and are pinkish and whorled with emerged bract-like leaves just below each whorl. This species has been found along the Rio Grande and at the terminal end of the Closed Basin canal on the Alamosa Refuge. This noxious plant was discovered in the late 1990s by the Alamosa County Weed Board. Although it can produce a thick vegetative mat that degrades water quality, reduces dissolved oxygen levels, and replaces native plant communities, these effects have not occurred on the Alamosa Refuge. However, populations of this plant continue to be a concern. To date, no control of this species has occurred either on the refuge or elsewhere in the San Luis Valley.

Saltcedar

This is a deciduous tree (or shrub) with long, slender branches and deep pink flowers. It is long-lived (50-100 years) and grows to 6 to 26 feet (2-8m) tall. The branches often form thickets many feet wide. The narrow leaves are small (1.5 cm) and grayish green, often overlapping and crowding on the stems. The leaves have the appearance of a conifer. Saltcedar is a native of Eurasia. Saltcedar typically occupies sites with intermediate moisture, high water tables, and minimal erosion, and mainly occurs along floodplains, riverbanks, stream courses, salt flats, marshes, and irrigation ditches in arid regions of the Southwest. It often forms pure stands in disturbed riparian areas of the Southwest.

Riparian ecosystems have been detrimentally affected by saltcedar throughout the southwestern United States. In many places, monotypic stands of saltcedar aggressively replace willows, cottonwoods, and other native riparian vegetation. Saltcedar can consume enormous amounts of water, and a single large plant can absorb 200 gallons of water a day. This can result in the lowering of the ground water, drying up of springs and marshy areas, and a reduction in the water yield of riparian areas. Saltcedar's dense roots can slow down river flow, increasing deposition and sediments along the riverbank. This can lead to saltcedar colonization further into the floodplain, widening the riparian zone and resulting in severe reduction of streamflow or even rechanneling. On the other hand, saltcedar root systems can also lead to flooding through choking of the watercourse. Although it can provide nesting areas for some species, compared with native vegetation, the density and diversity of birds decreases dramatically when saltcedar is present. Saltcedar communities also tend to have smaller numbers of insects as well. Although saltcedar occurs in the San Luis Valley, most occurrences are isolated plants or small patches on all three refuges. Because the establishment of this species is of great concern, all plants have been detected early and infestations have been controlled by mechanical and chemical methods while the plants were young.

Russian Olive

This is a perennial tree or shrub native to Europe and Asia. The plant has olive-shaped fruits, which are silver at first but then become yellow-red when mature. Russian olive can reproduce by seeds or root suckers. Seeds can remain viable for up to 3 years and are capable of germinating in a broad range of soil types. Spring moisture and slightly alkaline soil tend to favor seedling growth. The plant's extensive root system can sprout root suckers frequently. The stems can reach up to 30 feet in height with branches and trunks that have 1- to 2-inch thorns. Russian olive can grow in a variety of soil and moisture conditions, but prefers open, moist riparian zones. It is shade tolerant and can be found along streams, fields, and open areas. Russian olive can outcompete native vegetation, interfere with natural plant succession and nutrient cycling, and tax water reserves. Because Russian olive is capable of fixing nitrogen in its roots, it can grow on bare mineral substrates and dominate riparian vegetation. Although Russian olive can provide a plentiful source of edible fruits for some birds, ecologists have found that bird species richness is higher in riparian areas dominated by native vegetation.

Similar to saltcedar, few large stands of Russian olive exist in the San Luis Valley, though isolated patches and individual plants are common throughout the San Luis Valley and on all three refuges. Few attempts have been made throughout the years to eradicate this species from the refuges. Our observations are that Russian olive appears to be spreading throughout the refuges, and in recent years we have increased our efforts to eradicate this species. Removal of new plants will continue across the refuge complex.

Yellow Toadflax

This is a perennial weed that is native to south-central Eurasia; it was imported into North America in the late 1600s. Vegetative shoots usually emerge in mid-summer, growing to between 1 and 3 feet tall. Flowering may not start until late July. Once established, toadflax can easily spread into adjacent areas through its quickly developing root system, outcompeting native vegetation for resources. Toadflax is difficult to control, and an integrated management approach is most successful with this species. Yellow toadflax can quickly colonize disturbed areas and expand into undisturbed sites. Yellow toadflax occurs along the upper reaches of riparian habitat along north Crestone Creek in the Baca Refuge. The distribution of this plant appears to be limited to this area, and efforts are in place to eradicate the species through an integrated approach.

Swainsonpea

This is a perennial plant that branches out from the base with a woody taproot and rhizome. Swainsonpea is native to Asia. It is considered a watch list species in the State of Colorado, meaning that it may pose a potential threat to the environment, and information is being collected to make that determination. Flowers are brick red to purple and form into seed pods containing many seeds. Reproduction can occur vegetatively through rhizomes or by seed. Like many invasive plants, new populations can quickly colonize disturbed sites. These plants can grow up to 5 feet tall, but are usually 2-3 feet tall. The seed size is similar to alfalfa, so it can easily be a contaminant of that crop, and its presence in the San Luis Valley is of high concern. Swainsonpea has a patchy distribution at the Baca Refuge, and it appears to be spreading. Efforts are in place to eradicate this species using an integrated approach.

Threatened and Endangered Species (Federal) and Species of Concern

Table 13 shows the potential for occurrence of endangered species, threatened species, and species of concern on or near the refuge complex. Southwestern willow flycatcher is the only endangered species with an established presence on the refuge complex.

Table 13. Threatened, endangered (Federal), and other species of concern that potentially occur on the refuge complex.

Common name / scientific name	*Status*	*Range/habitat needs*	*Potential for occurrence on or near the three refuges*	*Eliminated from detailed analysis*
Mammals				
Townsend's big-eared bat *(Corynorhinus townsendii)*	SC	**Range:** Occurs throughout the western U.S. **Habitat:** Highly associated with caves and mines. Susceptible to disturbance at roost sites. Periodically moves to alternate roosts and actively forages and drinks throughout the winter. Foraging associations include edge habitats along streams and within a variety of wooded habitats.	Moderate. Suitable foraging habitat exists within the three refuges.	No
Northern pocket gopher *(Thomomys talpoides agrestis)*	SC	**Range:** This subspecies occurs in the San Luis Valley north and east of the Rio Grande. **Habitat:** A wide variety of vegetation communities including semidesert shrublands, grasslands, forests, and alpine tundra.	High. This species has been documented east of the Baca Refuge on the Baca Grande.	No
New Mexico Meadow Jumping Mouse *(Zapus hudsonius)*	FP	**Range:** Southwestern United States including riparian areas along the Rio Grande. **Habitat:** Prefers riparian habitat and requires permanent free-flowing water.	Low: The presence of this species is unknown in the San Luis Valley Conservation Area. However, protection of riparian corridors of the San Juan and northern Sangre de Cristo Mountains within the proposed San Luis Valley Conservation Area could give the species the adaptive capacity to persist in the likely range contractions in more southerly parts of its range.	No

Table 13. Threatened, endangered (Federal), and other species of concern that potentially occur on the refuge complex.

Common name / scientific name	*Status*	*Range/habitat needs*	*Potential for occurrence on or near the three refuges*	*Eliminated from detailed analysis*
Black-footed ferret *(Mustela nigripes)*	FE, SE	**Range:** Isolated locations in South Dakota, Wyoming, Utah, and Colorado. **Habitat:** Prairie dog colonies. Uses the burrows as living quarters and nurseries.	Low. Suitable habitat occurs within Gunnison's prairie dog colonies on the Baca Refuge. However, the nearest known population is located in northwest Colorado.	Yes
Wolverine *(Gulo gulo)*	FP, SE	**Range:** Throughout boreal forest and tundra regions of North America. Several records exist for Colorado and some recent observations have occurred. **Habitat:** Boreal forests, bogs, lowlands, and tundra. Dens are typically in log jams, under rocks and boulders, or under tree roots.	Low. There is no suitable habitat in the three refuges.	Yes
Canada lynx *(Lynx canadensis)*	FT, SE	**Range:** Found throughout Canada and Alaska as well as the high elevation forests of Colorado, Utah, Wyoming, Montana, and Idaho. **Habitat:** Coniferous forests such as spruce-fir with well-developed understories. Uneven aged stands of spruce-fir with rock outcrops and large boulders are the preferred habitat. Dens are typically under ledges, trees, or deadfalls, but are occasionally in caves.	Low. Found in San Juan and Sangre de Cristo Mountains. The Culebra Range of the Sangre de Cristo Mountains has been identified as a particularly important corridor for the species and within the Sangre de Cristo Conservation Area. Most lynx habitat within the San Luis Valley Conservation Area is already protected. There is no suitable habitat in the three refuges.	Yes
Gray wolf *(Canis lupus)*	FE, SE	**Range:** Found in Wyoming, Montana, Idaho, north central Utah, and other States. Mexican gray wolf (*Canis lupus baileyi*) is found in the Blue Mountains in New Mexico and Arizona. **Habitat:** Ungulates are the typical prey source for wolves, but they will also eat smaller mammals, birds, and fish.	None. In Colorado, the gray wolf is an extirpated species that no longer exists in the wild in its historical habitat. (Refer to chapter 3.)	Yes. (Refer to end of chapter 3.)
		Birds		
Bald eagle *(Haliaeetus leucocephalus)*	SC	**Range:** Throughout Colorado; however, most breeding occurs along the front range and western parts of the State. **Habitat:** Generally nests and roosts in proximity to large water bodies including rivers, lakes, and reservoirs. Nests in large trees such as cottonwood and ponderosa pine. Breeding season is February 15–July 15.	High. Occurrence is limited to migrating and wintering individuals. Most of the bald eagle use is along Crestone Creek and Alamosa Refuge.	No

Table 13. Threatened, endangered (Federal), and other species of concern that potentially occur on the refuge complex.

Common name / scientific name	*Status*	*Range/habitat needs*	*Potential for occurrence on or near the three refuges*	*Eliminated from detailed analysis*
Ferruginous hawk *(Buteo regalis)*	SC	**Range:** Throughout the Great Plains and grassland/shrub-steppe areas of western North America. **Habitat:** Open grassland and shrub-steppe habitats. Nests on the ground, usually on a hill or rock outcrop. Forages over open country. Breeding season is March 15–July 15.	High. This species has been documented foraging around wetlands and marshes within the three refuges.	No
American peregrine falcon *(Falco peregrinus anatum)*	SC	**Range:** Primarily found in western Colorado but breeding pairs also are found along the front range. **Habitat:** Foothill and mountain cliffs surrounded by pinyon-juniper or ponderosa pine woodlands. Nest sites consist of a small depression on a cliff ledge. Breeding season is March 15–July 15.	High. This species has been documented foraging around wetlands and marshes within the project area. However, there is no known nesting habitat near the three refuges.	No
Gunnison sage-grouse *(Centrocercus minimus)*	FC, SC, proposed for listing	**Range:** In Colorado this species is found primarily in Gunnison County with small scattered populations in Montrose, San Miguel, Mesa, and Saguache counties. **Habitat:** Sagebrush grasslands. Leks are located in open areas in proximity to escape cover. Nests are located in sagebrush habitat, typically within 2 miles of the lek. Broods are raised in wet, grassy areas near sagebrush. Winter habitat consists of south and east facing slopes with minimal snow cover. Breeding season is March 15–July 1.	None. Little suitable sagebrush grasslands within the three refuges. A small population is found near Poncha Pass, northwest of the Baca Refuge. This area would be protected as part of the San Luis Valley Conservation Area.	Yes
Greater sandhill crane *(Grus canadensis tabida)*	SC	**Range:** In Colorado this species breeds in the northwest portion of the State and migrates through the San Luis Valley in the fall and spring. **Habitat:** Flooded fields, wetlands, marshes, meadows, and agricultural fields. Breeding season is April 1–July 15.	High. A large number of greater sandhill cranes, part of the Rocky Mountain population, migrate through the San Luis Valley in the fall and spring.	No
Western snowy plover *(Charadrius alexandrinus)*	SC	**Range:** Found along artificial reservoirs in southeast Colorado and alkali-covered playas in the San Luis Valley. **Habitat:** sandy beaches, dry salt flats, river bars, and alkali-covered playas. Breeding season is April 1–July 15.	High. This species has been documented approximately 15 miles south of the Baca Refuge near San Luis Lake.	No

Table 13. Threatened, endangered (Federal), and other species of concern that potentially occur on the refuge complex.

Common name / scientific name	*Status*	*Range/habitat needs*	*Potential for occurrence on or near the three refuges*	*Eliminated from detailed analysis*
Mountain plover *(Charadrius montanus)*	SC	**Range:** Western North America with the largest breeding populations found in Colorado and eastern Montana. **Habitat:** Native short-grass prairie, stunted shrublands, agricultural fields, and overgrazed pastures. Breeding season is April 1–July 15.	High. Only a few records exist for the San Luis Valley, although this species was observed east of the project area on the Baca Grande in 2005. Suitable habitat occurs within the Baca Refuge.	No
Long-billed curlew *(Numenius americanus)*	SC	**Range:** Found primarily in southeastern Colorado with isolated populations in the northeast and northwest Colorado. **Habitat:** Short-grass prairie with scattered playas. Feeds along lake and reservoir edges during migration. Breeding season is April 1–July 15.	High. This species has been documented migrating through all three refuges. Suitable nesting habitat occurs within the project area.	No
Western yellow-billed cuckoo *(Coccyzus americanus)*	FC, SC; proposed for listing	**Range:** In Colorado, this species is primarily found west of the continental divide along riparian areas. **Habitat:** Old growth riparian woodlands with dense understory. Nests are typically located high in trees with closed canopies. Breeding season is April 15–July 15.	Moderate. This species has been documented in dense, old-growth cottonwood forests near McIntire Springs. Suitable habitat occurs near the Alamosa Refuge.	No
Burrowing owl *(Athene cunicularia)*	ST	**Range:** Found primarily in eastern Colorado as a summer resident, although small populations occur in the western Colorado and the San Luis Valley. **Habitat:** Open country from desert scrub to grasslands. Often found in or around prairie dog colonies. Nests in burrows. Breeding season is March 15–August 15.	High. This species has been documented nesting at several locations on the Baca Refuge.	No
Southwestern willow flycatcher *(Empidonax traillii extimus)*	FE, SE	**Range:** Southwestern U.S. and Mexico. In Colorado, this species has been found in the southwest corner of the State and the San Luis Valley. **Habitat:** Riparian areas with lush willows. Breeding season is April 15–July 15.	High. This species has been documented on the Alamosa Refuge and at Rio Grande and Higel State Wildlife Areas.	No

Table 13. Threatened, endangered (Federal), and other species of concern that potentially occur on the refuge complex.

Common name / scientific name	Status	Range/habitat needs	Potential for occurrence on or near the three refuges	Eliminated from detailed analysis
Amphibians				
Boreal toad *(Bufo boreas boreas)*	SE	**Range:** In Colorado, this species is restricted to the Rocky Mountains and is found at elevations between 7,000 and 12,000 feet. **Habitat:** Restricted to areas with suitable breeding habitat in spruce-fir forests and alpine meadows. Breeding habitat is lakes, marshes, ponds, and bogs with sunny exposures and quiet, shallow water. Breeding season is April 15–August 15.	None. There is no suitable habitat within the three refuges.	Yes
Northern leopard frog *(Rana pipiens)*	SC	**Range:** Once the most widespread frog species in North America, this species has been drastically declining in the last 50 years. In Colorado, this species is found statewide except for the southeast and east-central part of the State. **Habitat:** Typical habitats include wet meadows and the banks and shallows of marshes, ponds, glacial kettle ponds, beaver ponds, lakes, reservoirs, streams, and irrigation ditches. Breeding season is April 15–August 15.	High. Suitable habitat exists on all three refuges.	No
Invertebrates				
Uncompahgre fritillary *(Boloria acrocnema)*	FE	**Range:** This butterfly is endemic to the high alpine meadows of the San Juan Mountains in southwestern Colorado. **Habitat:** This species of butterfly lives in patches of snow willow *(Salix* spp.*)* at high elevations as well as moist tundra with dwarf willows above 13,000 feet.	None. The refuges are outside of the species' range and there is no suitable habitat in the refuge complex.	Yes
Fish				
Rio Grande sucker *(Catostomus plebeius)*	SE	**Range:** Historically, this species was found throughout the Rio Grande system. In Colorado, this species is now limited to several small tributaries of the Rio Grande. **Habitat:** This species prefers small streams with clear water, pools, and riffles.	High. This species is found on the Baca Refuge along Crestone Creek.	No

Table 13. Threatened, endangered (Federal), and other species of concern that potentially occur on the refuge complex.

Common name / scientific name	*Status*	*Range/habitat needs*	*Potential for occurrence on or near the three refuges*	*Eliminated from detailed analysis*
Rio Grande chub *(Gila pandora)*	Proposed for listing 2013	**Range:** In Colorado this species' range is restricted to the Rio Grande Basin. **Habitat:** This species prefers pools of small to moderate streams near areas of current.	High. This species is found on the Baca Refuge in Crestone Creek and Willow Creek.	No
Rio Grande cutthroat trout *(Oncorhynchus clarki virginalis)*	FC, SC	**Range:** In Colorado this species' range is confined to the headwaters of the Rio Grande surrounding the San Luis Valley. **Habitat:** This species, like other cutthroat trout species, prefers clear, cold streams and lakes.	Moderate. This species is known to occur in the Saguache Creek drainage west of the project area and in the San Luis Creek drainage northwest of the Baca Refuge. This species occurs in perennial streams, but has never been documented in Crestone Creek, the only perennial stream in the project area.	Yes

Abbreviation Status:

FE - Federally Endangered	FP - Federally Proposed
FT - Federally Threatened	SE - State Endangered
FC - Federal Candidate	ST - State Threatened
	SC - State Species of Concern

Primary sources: Fish and Wildlife Service endangered species database (FWS 2013c); Colorado Parks and Wildlife threatened and endangered list (CPW 2013c); Final Baca oil and gas environmental assessment (FWS 2011b); Sangre de Cristo Conservation Area land protection plan (FWS 2012b); Final interim elk management plan and environmental assessment for San Luis Valley National Wildlife Refuge Complex (FWS 2013e).

Note: Several other birds of concern found on the refuge complex are discussed in chapter 3 in tables 3, 4, and 5, or in the text.

Southwestern Willow Flycatcher

The southwestern willow flycatcher *(Empidonax traillii extimus)*, one of four subspecies of the willow flycatcher, is a small neotropical migrant that can be fairly abundant along the Rio Grande on the Alamosa Refuge, and in other riparian habitats within the San Luis Valley. In recent years, however, the hydrology of the Rio Grande through Alamosa Refuge appears to be limiting the number found. The subspecies was listed as federally Endangered in 1995 (FWS 1995). Arizona, New Mexico, and California are the core of the southwestern willow flycatcher's historic and current range (Owen and Sogge 1997). Southwestern Colorado may have been used by breeding southwestern willow flycatchers, but nesting records are lacking (FWS 1995). Determining the boundaries of this subspecies' range has been difficult for several reasons, including the limited number of museum specimens from some regions including southwestern Colorado (Paxton 2000), the difficulty in separating breeders from migrants in many areas, and the lack of data on willow flycatchers in south-central Colorado (Owen and Sogge 1997). In general, southwestern willow flycatchers nest in dense stands of mixed willows that are adjacent to or near open water or that are temporarily flooded, at least during nest initiation.

Genetic studies have been conducted to evaluate the genetic composition of willow flycatchers, including those captured in the San Luis Valley. A 1996-1997 study conducted by the Colorado Plateau Field Station (Owen and Sogge 1997) evaluated the number, location, and extent of willow flycatcher breeding sites and analyzed genetic characteristics of willow flycatchers at 20 sites in Arizona, California, New Mexico, and Nevada, as well as at five sites in Colorado, including the Alamosa Refuge and McIntyre Springs (which is managed by the BLM) (Owen and Sogge 1997). The results suggest that considerable genetic diversity exists both within the *extimus* subspecies and within local breeding sites (Busch et al.

2000). Another study examined the molecular genetic structure of willow flycatchers throughout their range, and the results show that the flycatchers sampled on the Alamosa Refuge and at McIntyre Springs belong to the endangered *extimus* subspecies. Southwestern Colorado, however, proved to be the intergrade zone between the *extimus* and the northern neighboring *adatmus* subspecies (Paxton 2000).

The 1995 listing (FWS 1995) identified the entire San Luis Valley as being within the breeding range of *extimus*. In 2013, critical habitat was designated, which included 8,345 acres of the Alamosa Refuge (FWS 2013b), including the entirety of the riparian corridor as well as other areas. Management of the southwestern willow flycatcher will be guided by the *Recovery Plan* approved in December 2002 (FWS 2002).

Management Activities

We manage habitats within the refuge complex through water management (see discussion under physical environment), rest, and prescribed grazing, haying, mowing, and fire.

Rest

Dense stands of wetland vegetation are an important part of migratory bird habitat on all three refuges. This has been documented for ducks on the Monte Vista Refuge (Gilbert et al. 1996), but likely applies to other species nesting in associated habitats, such as American bittern, sora, Virginia rail, northern harrier, and short-eared owl. Production of this dense undisturbed vegetation distinguishes the refuges in the San Luis Valley from almost all lands in agricultural production. Although irrigation practices are fundamentally the same on agricultural lands and lands that are used by nesting water birds, the use of the resulting vegetation is dramatically different. Farmers and ranchers depend on the harvest of vegetation for their livelihoods; however, waterbirds need stands of vegetation that are largely excluded from harvest. Because of this, the refuges provide important islands of nesting cover within the San Luis Valley and the flyway.

Stands of dense vegetation are achieved through careful water manipulation and rest from management practices that result in defoliation, such as grazing, fire, herbicide, haying, and mowing. Although the use of rest has tremendous value for a wide variety of birds, it is not feasible or desirable to constantly keep all of the refuge complex's wetland habitats in a densely vegetated state. In the cool climate of the mountain valley, decomposition occurs slowly and organic matter allowed to accumulate over too many years will shade the soil and suppress the new growth of desired vegetation. Therefore, it is necessary to periodically disturb dense stands of vegetation to accelerate the breakdown of organic matter, hasten mineral cycling, reduce invasive weed densities, and create vegetative structural diversity.

Prescribed Grazing

Prescribed grazing has occurred at varying degrees on all three refuges since they were established. Prescribed grazing is the planned application of livestock grazing in a specified area, season, duration, frequency, and intensity to achieve specific vegetation objectives. The objectives are designed to meet the broader habitat and wildlife goals. Instead of managing the refuges for livestock grazing or other economic uses, livestock grazing is used as a tool to improve wildlife habitat (FWS 2001). On the three refuges, we work with local livestock owners who are issued annual special use permits specifying the location, timing, duration, and intensity of grazing so that habitat management objectives can be met.

The primary use of livestock grazing on the refuges is to enhance desirable plant growth and vigor in wetland habitat and for invasive weed control. Grazing in wetland habitats is used to reduce the accumulation of organic litter at the surface. A large amount of organic litter often favors invasive species such as Canada thistle and tall whitetop. Removal of this litter layer stimulates the growth, spread, and vigor of desirable plants that will help out-compete invasive plant species. Increased plant height and density, especially of Baltic rush, is also beneficial to many nesting waterfowl species during the period these areas are rested (Gilbert et al. 1996). Prescribed grazing, coupled with other treatments such as flooding, prescribed fire, and herbicide application, is used to help with direct control of invasive weeds, especially tall whitetop. For example, grazing has been used early in the growing season when rosettes and young stems are eaten by cattle. Cattle are removed when they no longer consume plants in the later growth stage, and these plants are then treated with herbicide to further control infestations. Sheep grazing has been used to target Russian knapweed infestations. Once the sheep are removed, herbicide is applied. The refuges have experienced significant control in these areas using this combination of treatments. Recently, prescribed grazing (primarily with cattle) has been used to achieve a specific vegetative structure that benefits bird species that require moderate vegetation height for nesting and foraging, such as Wilson's phalarope, Wilson's snipe, and cinnamon teal. Prescribed grazing is used to create heterogeneity in vegetation structure as compared to tools such as haying and mowing or prescribed fire that uniformly affect the height of vegetation.

When prescribed grazing is used to meet habitat, wildlife, and other land management goals, it can be an extremely effective tool. For example, short-duration, high-intensity grazing treatments can be used to control invasive plants. Grazing can also be used to manipulate vegetative structure to meet the nesting or foraging needs of specific wildlife species. After a period of rest, grazing can be used to remove excess plant material to stimulate the establishment, growth, spread, and vigor of desirable plant species.

Natural herbivory by elk and bison once occurred on all three refuges, where large herds grazed for short intervals, moved to other sites when forage resources diminished, and returned when the vegetation had recovered. This strategy allowed plant species to recover without being defoliated to the point where they could not regrow. Consequently, both plant and wildlife species evolved with this disturbance regime and overall habitat health was sustained.

Prescribed Haying and Mowing

Similar to prescribed grazing, prescribed haying and mowing are used to meet specific vegetation objectives. Haying and mowing are used to remove the buildup of residual vegetation in wetland habitats and promote the growth, spread, and vigor of desirable plant species. As with other mechanical activities, guidance and policy are followed to help avoid disturbing ground-nesting birds. Timing and other factors are considered to encourage desired plant species and habitat conditions and to discourage the establishment of invasive weeds.

Prescribed Fire

Prescribed fire is a wildland fire intentionally used to meet specific objectives that are identified in a written, approved prescribed fire plan. As a management tool, we use prescribed fire to achieve fuel reduction, resource protection, community protection, and our habitat management goals.

By using prescribed fire, the refuges are able to reduce and remove dead and decadent vegetation, which allows vegetation to regenerate which promotes increased wildlife use of these habitats. Removal of dead and decadent vegetation with prescribed fire also removes fuel that could create a destructive wildfire. Fire characteristics and the resulting effects are dependent on fuel type, weather, and topographic conditions. After a prescribed fire, light, moisture, and nutrients that would have otherwise been blocked by or tied up in dead and decadent vegetation become available to regenerating plants (FWS 2013f).

Prescribed fire has been used or is planned in all major habitat types on the refuges, except for riparian habitat, although the refuges are investigating the use of prescribed fire to help riparian habitats. Before prescribed fire is used, specific procedures that set priorities for human safety are set. All prescribed fires will be monitored in accordance with Service policies and the specifics of the burn plans. One of the main directives of Federal land management is to let agency directives, the best available science, and ecological principles dictate management (Dombeck et al. 2004). An intensive vegetation and wildlife inventory is a part of successful fire management. Climate change may continue to increase temperatures and fire season duration, creating new complications for management strategies (Stephens et al. 2009). As the climate changes and plant communities change accordingly, it is the responsibility of land managers to be aware of these issues and plan for them in advance. Habitat monitoring will be crucial for determining vegetation trends and how fire should be used to enhance wildlife habitat in the

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Prescribed fire is used as a habitat management tool on the refuge complex.

changing environment. Arno et al. (2000) describe the importance of adaptive management and the need to study fires, learn from them, and more importantly, adapt to the new patterns.

We conduct prescribed burns under an approved interagency fire management plan (NPS, FWS, TNC 2006), complying with all regulations and guidelines established by the Colorado Department of Public Health and Environment (Air Pollution and Control Division). The interagency program consists of fire professionals from the USFS, BLM, NPS, and the Service.

Unlike a prescribed fire, a wildfire is a wildland fire originating from an unplanned ignition, usually caused by lightning, unauthorized and accidental human-caused fires, and escaped prescribed fires. Past and current management of the refuges has been to fully suppress all wildfires. Some of the other Federal land management agencies (BLM, USFS, and NPS) have allowed some wildfires to be managed to help achieve benefits.

Bird Species

Providing habitat for migratory birds is a central mission of the refuge complex.

Focal Birds

Focal birds serve as indicator species on the refuge complex. These are species that regularly nest on one or more of the refuges; are species of conservation priority or concern listed in local, State, regional, or national conservation plans; or have been named as target species. The focal birds for the major habitat types on the refuge complex are listed below. (Refer also to tables 3, 4, and 5 in chapter 3.)

- Wetland (tall-emergent/short-emergent/wet meadow/playa): mallard, cinnamon teal, American bittern, white-faced ibis, greater sandhill crane, American avocet, Wilson's phalarope, and Savannah sparrow
- Upland: Brewer's sparrow and western meadowlark
- Riparian: southwestern willow flycatcher and western wood-pewee

Waterfowl

The refuges support several priority waterfowl species that are highlighted in the North American Waterfowl Management Plan (DOI [FWS], SEMARNAP Mexico, Environment Canada 1998). Mallard, northern pintail, and lesser scaup, which are named as high-priority species in the plan, use the refuges for either nesting or migration. Substantial numbers of mallards and smaller numbers of northern pintails nest on the Monte Vista and Alamosa Refuges, while lesser scaup is primarily a spring and fall migrant. Other priority waterfowl species named in the plan that use the refuges include redhead, wood duck, canvasback, American wigeon, and ring-necked duck. Most of these species use the refuges as migration stopovers, but redheads and American wigeon are common breeders.

In general, the Baca Refuge supports few numbers of breeding waterfowl, but the Monte Vista and Alamosa Refuges may support breeding waterfowl in large numbers, depending on habitat conditions. Canada goose, mallard, gadwall, cinnamon teal, blue-winged teal, green-winged teal, northern pintail, northern shoveler, American wigeon, redhead, and ruddy duck commonly nest on the Monte Vista and Alamosa Refuges. During nesting season, the Monte Vista Refuge has one of the highest densities of nesting ducks on the continent (Gilbert et al. 1996). In the mid-1990s, 15,000 ducks were produced on the Monte Vista Refuge annually, which constitutes a major part of the State's population and subsequently the central flyway's population. The Alamosa Refuge also produced 5,000 to 8,000 ducks annually. Drier conditions over the last decade have resulted in few ducks being produced compared to the 1980s and 1990s; the number of ducks currently being produced is unknown. Because water availability on the Baca Refuge can be limited and habitats are not as conducive to meeting the breeding needs of many waterfowl species, waterfowl use of this refuge is much lower than on the Monte Vista and Alamosa Refuges.

Numbers of wintering waterfowl in the San Luis Valley vary depending on weather conditions and, consequently, the availability of unfrozen water and waste grain. In the early part of the 20th century, waterfowl, primarily mallards, wintered on artesian-dependent wetlands that were found throughout the valley. By 1970, the increase in the human population and its demand for water, as well as the change from flood irrigation to center pivot sprinklers on local farms, significantly increased the overall demand for water. Subsequently, ground water levels dropped dramatically and most artesian wells ceased to flow, which decreased the amount of wetlands available to wildlife. From 1980 through 1990, most of the waterfowl wintering in the San Luis Valley (approximately 15,000 ducks) were using the Monte Vista Refuge where open water was still available. As a result of a high number of ducks concentrated into a relatively small area, avian cholera outbreaks became common in the winters after 1980. An average of 6,500 ducks died yearly from the disease between 1985 and 1990.

In 1990, the Service, through the Partners for Fish and Wildlife program and in cooperation with the Colorado Division of Water Resources, started actively securing and increasing wintering habitat on private lands. Local farmers were paid to keep some of their crops standing in the field during the winter in an attempt to disperse waterfowl across the San Luis Valley and reduce the large concentrations on the Monte Vista Refuge. This program was successful in that ducks dispersed to other areas within the valley and cholera mortality was significantly reduced. However, this program was costly and not designed to be a long-term solution. Since 1996, we have not actively provided wintering waterfowl habitat so that ducks will migrate south to the Middle and Lower Rio Grande Valley and into Mexico where better wintering habitats exist.

Canada geese nest on, migrate through, and often winter on the Monte Vista and Alamosa Refuges. Geese build their nests in areas of thick cattails in and along wetland edges and on vegetated levees. At one time, Canada geese were declining in numbers in many areas, so we placed nesting structures in wetlands throughout the two refuges. Canada goose numbers have increased so much that they have become overpopulated in some areas and have become a nuisance, especially in urban areas. Although most of the nesting structures have been removed, this species continues to nest on the refuges.

Lesser Canada geese spend a few days to weeks on the refuges during the spring and fall migrations. Occasionally, some greater white-fronted geese and tundra swans visit the refuges during migration if conditions are suitable.

Other Waterbirds

The refuges, particularly Monte Vista and Alamosa, support several waterbird species named as priority species in the Intermountain West Conservation Plan (Ivey and Herziger 2006), including greater sandhill crane, western grebe, Clark's grebe, eared grebe, pied-billed grebe, American white pelican, Forster's tern, black tern, Franklin's gull, American bittern, black-crowned night-heron, snowy egret, white-faced ibis, sora, and Virginia rail. Many of these species nest on one or more of the refuges. Others use refuge habitats only during migration.

Pied-billed grebes are the most common nesting grebe on the Monte Vista and Alamosa Refuges, while western and eared grebes breed in smaller numbers. Grebes breed in wetlands with deep water, where they build their nests on floating mats of cattail or bulrush.

Black-crowned night-herons, white-faced ibis, and snowy egrets nest on the refuge complex, often on the same bulrush islands. The Monte Vista Refuge supports one of the largest nesting colonies of white-faced ibis and snowy egret in the State. These colonial-nesting waterbirds can change nesting locations each year if habitat conditions vary; however, they have nested consistently on the Monte Vista Refuge for the last 20 years. Foraging ibis use wet meadow and marsh communities during the spring, summer, and fall. Snowy egrets and black-crowned night-herons use open, shallow water as well as wet meadows and marshes for foraging. American bitterns are common on the Monte Vista and Alamosa Refuges and breed and forage in dense cattail stands.

Little is known about habitat use and nesting success of secretive marshbirds such as Virginia rail and sora in the San Luis Valley. Virginia rail and sora nest on the refuge complex and are commonly observed during spring, summer, and fall in wet meadow and marsh communities. The number of rails produced on the refuge complex is unknown; however, these species and their young are regularly documented.

Shorebirds

The refuges provide important habitat for a wide variety of shorebirds. Twenty-three shorebird species have been documented on the refuges during different seasons of the year. Many of these species are migrants and use the refuges during spring and fall. Killdeer, American avocet, black-necked stilt, Wilson's phalarope, Wilson's snipe, and spotted sandpiper are the most common breeders. These species use a variety of nesting habitats from unvegetated flats and levees to flooded short-emergent vegetation and gravel roads.

The potential of the playa habitat on the Baca Refuge for providing nesting and foraging resources is significant. Because of numerous factors (see Playa Habitat), this playa system has received little to no water since the late 1980s. Should sufficient water be available to irrigate the playas, we expect that the diversity of shorebirds using this area would be substantial and that it would become an extremely important nesting area for numerous species.

Sandhill Crane

Three subspecies of sandhill cranes spend several weeks in the San Luis Valley during each spring and fall to rest and feed during migration. The Rocky Mountain population of the greater sandhill crane *(Grus canadensis tabida)* nests primarily in Wyoming and Idaho and winters in the Lower and Middle Rio Grande Valley, primarily at the Bosque del

Apache National Wildlife Refuge in New Mexico. Ninety-five percent of this population (approximately 18,000 to 20,000 cranes) and 5,000 to 6,000 lesser *(Grus canadensis canadensis)* and Canadian *(Grus canadensis rowani)* sandhill cranes migrate through the San Luis Valley. Spring migration occurs from mid-February through late March, with peak numbers in early March. Fall migration is from early September through mid-November, with peak numbers in mid-October.

Most of the crane use in the San Luis Valley is on and around the Monte Vista Refuge, primarily because there are suitable roost sites on the refuge and because there are private agricultural fields nearby where cranes feed extensively on barley and other small grains in the spring and fall. In the fall, local farmers harvest their crops, and cranes feed on the excess grain left in the fields. In recent years, farmers have been tilling or irrigating after harvest. As a consequence, the amount of waste grain on private agricultural fields has been limited during the following spring, when cranes are migrating north to their breeding grounds. The agricultural fields on the Monte Vista Refuge are left standing in the fall when adequate supplies of waste grain are available on neighboring fields. In the spring, refuge barley fields are cut but not harvested, which provides food for cranes when it is limited on private lands.

As well as providing important feeding sites in the spring, the Monte Vista Refuge has the largest roosting site in the San Luis Valley, and up to 15,000 cranes seek protection each night in the refuge's shallow-water wetlands. *Because of* the Monte Vista Refuge's water rights and the ability to pump ground water starting in late winter, suitable roost sites are available by mid-February, when shallow-water wetlands elsewhere in the San Luis Valley are still dry. By providing these important roost sites and high-energy food resources, we continue to support the Pacific and central flyway greater sandhill crane conservation and population goals.

Raptors

The San Luis Valley, including the three refuges, hosts an array of hawks, eagles, owls, and falcons throughout the year.

Red-tailed hawks and Swainson's hawks nest in trees on old homesteads and in large riparian trees. Red-tailed hawks and ferruginous hawks also commonly nest on utility poles in the valley. Northern harriers nest in dense vegetation in wet meadows as well as in tall-emergent wetland vegetation.

Great horned owls nest in deciduous and evergreen trees and on the banks of canals and water delivery ditches. Short-eared owls, like harriers, nest in dense vegetation in wet meadows.

Burrowing owls are declining in Colorado and are a species of management of concern in Region 6, Mountain-Prairie Region, and other western regions. Burrowing owl is a grassland species that often uses abandoned prairie dog tunnels for nesting. This species is rare to uncommon in the San Luis Valley as it is in most of the western valleys and mountain parks of Colorado (Andrews and Righter 1992). Habitat loss is responsible for some of the declines in the State; however, burrowing owls are missing from areas with apparently suitable habitat. Therefore, other factors may be involved (Andrews and Righter 1992).

They are uncommon on the Monte Vista and Alamosa Refuges because of lack of suitable habitat. Burrowing owls are more common on the Baca Refuge because it has more habitat and a few mid-sized prairie dog colonies. On the Baca Refuge, burrowing owls are usually found in unirrigated short-emergent wetlands and greasewood shrubland, with the main prey source being insects, small mammals, and birds. Burrowing owls occupy multiple areas outside of prairie dog colonies on the refuge using burrows dug by other mammals.

Peregrine falcons and prairie falcons hunt for shorebirds and other small waterbirds in the wetlands and wet meadows of the refuge complex during spring and fall migration. Peregrine falcon nesting is suspected in the mountains 5 miles west of the Monte Vista Refuge, and fledglings have been found in the southern valley near Jaroso (Dean Swift, personal communication [date unknown]). Kestrels nest in tree cavities, nest boxes, and other structures throughout the valley.

Red-tailed hawks, ferruginous hawks, rough-legged hawks, northern harriers, short-eared owls, golden eagles, and bald eagles are common winter residents on the refuge complex. The hawks, owls, and golden eagles find rodents, rabbits, and other prey in the uplands and short-emergent wetlands where cover is abundant. Bald eagles spend the winter feeding on waterfowl or on carrion. Most of the bald eagle use is on the Alamosa Refuge, where eagles extensively use the cottonwood trees along the Rio Grande. In February and March, the Alamosa Refuge is an important staging area for spring migrating bald eagles. During winter, golden eagles use the Baca Refuge for hunting small mammals.

Songbirds

The refuge complex provides habitat for a variety of migrating, nesting, and wintering songbirds and other birds. Nesting species include swallows, wrens, blackbirds, sparrows, and flycatchers. Songbirds nest and depend on all habitat types on the refuges, from uplands, which support sage thrasher, Brewer's sparrow, and loggerhead shrike, to dense cattails, which support common yellowthroat and marsh wren, to short-emergent grasslands, which support western meadowlark, Savannah sparrow, and vesper sparrow.

Riparian habitats, particularly on the Alamosa and Baca Refuges, support the greatest diversity of nesting and migrating songbirds, including southwestern willow flycatcher, western wood-pewee, yellow warbler, and Bullock's oriole. These species and many others that nest in riparian habitats are neotropical migrants that winter in Central or South America. All of these songbird species face a multitude of threats, from loss of habitat to the use of pesticides, and many songbird species are experiencing population declines throughout their range.

Other Wildlife Species

Large, medium, and small mammals; amphibians and reptiles; and fish are important parts of the biodiversity of the refuges.

Rocky Mountain Elk, Mule Deer, and Pronghorn

Rocky Mountain elk are native to the San Luis Valley, but the distribution and abundance of this species has changed in recent years. Figure 49 shows the summer and winter elk concentration areas in the San Luis Valley.

Before the mid-1980s, elk were rare on the Baca Refuge. CPW estimated less than 50 elk in 1988. In 1991, a district wildlife manager with CPW observed approximately 80 elk just south of the Baca Refuge, and in 1993, approximately 1,500 elk were observed on the refuge. From the mid-1990s to the present, the elk population on the Baca Refuge and in the surrounding area has continued to increase to a current population of more than 3,500.

On the Alamosa Refuge, there were no documented elk observations before 1997. In 1998, CPW issued private land-only elk hunting licenses to address elk damage to private lands near Fort Garland, Colorado. Pressure from these hunts pushed approximately 300 elk to the southern end of the Alamosa Refuge, although many left the refuge after the hunting season. In 1999, this occurred again, with about 400 elk being pushed to the Alamosa Refuge. Once again, many returned to the Fort Garland area after the hunting season. By 2009, the elk population on the Alamosa Refuge and in the surrounding area increased to more than 400 animals, with approximately 200 elk remaining on the Alamosa Refuge year-round.

On the Monte Vista Refuge, only a few elk were observed before the late 1980s. By 1989, there were approximately 300 elk spending the winter on the refuge, and by 1997 that number had increased to more than 900, of which approximately 70 had become year-round residents. In 1997, efforts were made to reduce elk numbers on the Monte Vista Refuge. Within 4 years, the number of elk wintering on the Monte Vista Refuge declined to less than 100, and the resident population was eliminated. Since 2003,

Mule deer are found across the refuge complex.

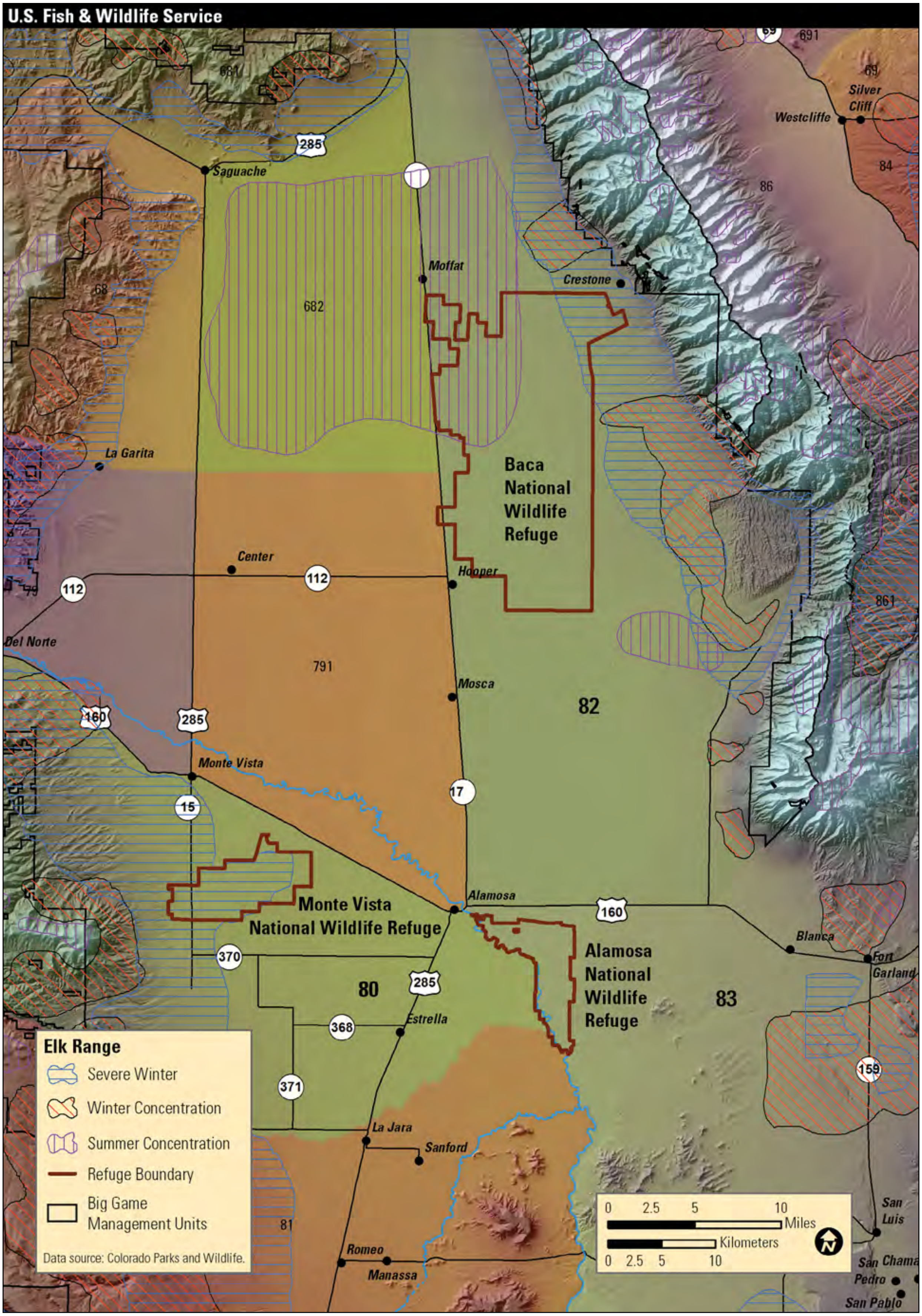

Figure 49. Summer and winter elk concentration areas in the San Luis Valley.

the wintering population has increased, but has remained fairly constant at approximately 250 elk. A year-round population of about 50 animals has become reestablished.

Elk overpopulation has resulted in vegetation damage and degraded habitat quality for many other species (see discussion under Riparian Habitat above). Because CPW is financially liable for damage to privately owned property, such as fences, forage crops, and other agricultural crops such as potatoes, they are extremely concerned about the rapidly growing elk populations on the refuges as well as throughout the San Luis Valley. Large numbers of elk on the refuges have resulted in conflicts with neighboring landowners as well as an increase in collisions with elk on State highways and county roads. The refuge staff coordinates closely with CPW to study populations and make decisions about potential elk population control or dispersal methods.

Mule deer occur on all three refuges. Deer feed and rest in agricultural fields on the Monte Vista Refuge and in other upland and wetland communities on the Monte Vista and Alamosa Refuges. On the Baca Refuge, deer are usually found in upland and riparian habitats in a small part of the refuge. Pronghorn occur on the Baca and Monte Vista Refuges, primarily in upland habitats and on the agricultural fields of the Monte Vista Refuge.

Midsized Mammals

Little is known about population sizes of midsized mammals found on the refuge complex, as few population surveys have been conducted. Coyote, red fox, striped skunk, raccoon, porcupine, beaver, badger, muskrat, mountain cottontail rabbit, white-tailed jackrabbit, long-tailed weasel, and American mink are some of the species that are common to abundant on the refuges. Some of these species, such as red fox, raccoon, striped skunk, and American mink, can be significant predators of ground nesting birds, especially waterfowl. These species can also keep rodent populations in check. Beaver and porcupine can impair riparian vegetation growth and survival, especially in areas where riparian habitat health is poor.

Bison

Historical accounts and archeological evidence prove that bison are native to the San Luis Valley, but their historic role in the ecology of the region is largely unknown. Jodry and Stanford (1996) uncovered an ancient bison kill site in the northern San Luis Valley from the Folsom period. In 1694, the Vargas Expedition reported seeing 500 bison in the San Luis Valley (Espinosa 1939, Simmons 1999). In the early 1800s, Zebulon Pike referenced bison in his accounts of expeditions in the Colorado mountains (Spencer 1975). Meaney and Van Vuren (1993) also documented bison in the valley by collecting and referencing specimens from Colorado museums and private collections. Observations of bison in the valley were rare after the mid-1800s.

In North America, before their extirpation in the late 1800s, bison were an important factor in the ecology of tall grass prairies (Knapp et al. 1999). Bison also contribute to the heterogeneity of various habitats by grazing, rubbing, wallowing, and pounding, and they help shape ways in which fire, water, soil, and energy move across the landscape (Knapp et al. 1999, Sanderson et al. 2008). Historic vegetative communities on the Baca Refuge include upland salt desert shrub, grasslands, shrublands, wet meadow, riparian woodland, and playa wetlands (Heitmeyer and Aloia 2013b). The effects that grazing bison have on these plant communities and other native wildlife species are not well understood.

Small Mammals

Twenty-eight species of small mammals have been documented in the refuge complex, including Wyoming ground squirrel, thirteen-lined ground squirrel, northern pocket gopher, plains pocket mouse, silky pocket mouse, Ord's kangaroo rat, northern grasshopper mouse, meadow vole *(Microtus pennsylvanicus)*, long-tailed vole *(Microtus longicaudus)*, western harvest mouse, *(Reithrodontomys megalotis)*, and deer mouse *(Peromyscus maniculatus)*. Many of these small mammals are an important food resource for raptors, especially during the fall and winter.

Bats include long-eared myotis *(Myotis evotis)*, little brown myotis *(Myotis lucifugus)*, and big brown bat *(Eptescius fuscus)*. Bat species help to control the populations of insects such as mosquitoes, which can in turn help reduce the spread of disease such as West Nile virus.

Gunnison's Prairie Dog

From 2008 to 2013, the Gunnison's prairie dog (*Cynomys gunnisoni*) was listed as a candidate species for Federal protection under the Endangered Species Act. Protection of the species was considered for the following reasons: a reduction in population size and number, primarily because of sylvatic plague, habitat fragmentation, poisoning, and shooting (FWS 2009). More recent information shows that the overall prairie dog metapopulation structure seems to be stable, and no threats are causing or projected to cause the species to be at risk for extinction

(FWS 2013d). Gunnison's prairie dogs are native to the San Luis Valley, and a sizeable population occurs on the Baca Refuge.

Plague is the biggest risk to the prairie dogs, as severe outbreaks can kill more than 99 percent of the population. The disease occurs at low levels throughout the range of the prairie dog, cycling through periods of low and high intensities. Conditions such as temperature, moisture, and susceptibility of hosts can trigger a severe outbreak. When it's not causing severe disease outbreaks, the plague bacterium can persist in soil, in the flea population, or by slowly spreading among prairie dogs or other mammal species where the disease is relatively nonlethal (FWS 2013d, Biggins et al. 2010). According to the FWS 12-month finding on a petition to list the Gunnison's prairie dog as an endangered or threatened species (FWS 2013d), plague causes wide fluctuations in population numbers, but the Gunnison's prairie dog has demonstrated the resiliency and redundancy to return to pre-outbreak numbers and remain viable in the future. Conservation efforts are in place to continue to reduce the disease in the population. CPW has a program to proactively manage against plague by dusting burrows in prairie dog colonies with insecticide. Dusting reduces the abundance and occurrence of fleas, improving the chances of survival for the prairie dogs. Refuge managers will continue to work with the State to proactively manage against plague by dusting burrows with insecticide. A new vaccine-laden bait that could inoculate prairie dogs from plague is in the experimental phase and may be available in the future as a management tool to reduce the risk from plague. If the vaccine becomes available, managers will consider using it.

Gunnison's prairie dog habitat on the Baca Refuge is restricted to about 500 acres along the northern boundary. Most of their habitat is in marginal condition and is dominated by patches of bare soil and invasive weeds such as kochia, Russian thistle, hoary cress, bindweed, and Russian knapweed. The prairie dogs occupy areas that were once farmed with center pivot sprinklers and areas that were overgrazed by cattle. Refuge managers have plans to convert these areas to more suitable prairie dog habitat by reducing the abundance and distribution of invasive weeds and by promoting native grasses through plantings. Improving the habitat would promote the conservation and survival of this species.

Amphibians and Reptiles

The altitude, climate, and relative isolation of the San Luis Valley limits the number of amphibians and reptiles found on the refuge complex (L. Harvey, personal communication [date unknown]). Common species include tiger salamander *(Ambystoma tigrinum)*, Woodhouse's toad *(Bufo woodhousii)*, Great Plains toad *(Bufo cognatus)*, western chorus frog *(Pseudacris triseriata)*, Plains spadefoot toad *(Spea bombifrons)*, and western terrestrial garter snake *(Thamnophis elegans)*. On the Baca Refuge during certain times of the year, the number of Great Plains and Woodhouse's toads can be extremely large. Other species that are occasionally observed or that may occur on one or more of the refuges include northern leopard frog *(Rana pipiens)*, bullsnake *(Pituophis catenifer)*, western rattlesnake *(Crotalus viridis)*, variable skink *(Eumeces gaigeae)*, short-horned lizard *(Phrynosoma hernandesi)*, smooth green snake *(Opheodrys vernalis)*, and fence lizard *(Sceloporus undulates)*.

The northern leopard frog was proposed for Federal listing, but in October 2011, the Service concluded that listing under the Endangered Species Act was not warranted. This species continues to be a species of high management priority for us.

Amphibians and reptiles require a mosaic of habitats suitable for breeding, foraging, protection, and overwintering. Habitat linkages are required to meet all life stages, allowing animals to migrate seasonally between different areas to feed, overwinter, and reproduce. The permeable nature of amphibian skin makes these animals extremely vulnerable to contaminants such as pesticides, fertilizers, heavy metals, and acidification in the environment (Pilliod and Wind 2008, Ellison 2011).

Bullfrogs *(Rana catesbeiana)* are not native to Colorado, but early introductions as a game species by Colorado Parks and Wildlife and accidental introductions with fish stock have led to firmly established populations along the Rio Grande corridor as well as in other isolated locations in the San Luis Valley. Surveys conducted on the refuge complex have not documented any bullfrogs, even though this species is prolific just upstream on the Rio Grande from the Alamosa Refuge. We continue to be concerned about the establishment of bullfrogs on the complex because of their ability to prey on and displace native amphibians such as northern leopard frogs and tiger salamanders.

Fish Communities

Fish live on all three refuges. On the Monte Vista and Alamosa Refuges, species such as brook stickleback *(Culaea inconstans)*, red shiner *(Cyprinella lutrensis)*, and common carp *(Cyprinus carpio)* enter the deeper wetland habitats via irrigation canals originating from the Rio Grande, but most fish die in the winter when the marsh freezes. On the Alamosa Refuge, northern pike *(Esox lucius)* and common carp are common and can survive the winters both in the Rio Grande and in the deeper canals and sloughs.

Northern pike are a concern as they can prey on native amphibians such as leopard frog, chorus frogs, and tiger salamander. Common carp are a concern as they can reduce water quality by increasing turbidity, resulting in reduced aquatic submergent plant growth and aquatic invertebrate production, which can affect forage resources for a wide array of wildlife species including waterfowl and amphibians.

Crestone Creek on the Baca Refuge is particularly important because four native fish species are found: the Colorado State endangered Rio Grande sucker *(Catostomus plebeius)*; Rio Grande chub *(Gila pandora)*, a Colorado State species of special concern; fathead minnow *(Pimephales promelas)*; and longnose dace *(Rhinichthys cataractae)*. No nonnative fish are known to occur.

The Rio Grande sucker occurs exclusively in the Rio Grande basin from Colorado to Mexico (Rees et al. 2005b). In Colorado, this species is limited to small creeks within the San Luis Valley, where it has been reintroduced, and two known historic populations, including Hot Creek (off the refuges) and Crestone Creek (on the Baca Refuge), where it prefers backwaters and pools near rapidly flowing water (Rees et al. 2005b). The Rio Grande sucker feeds primarily on algae; it typically spawns from February to April and may spawn a second time in late summer (Rees et al. 2005b). This species was first documented by CPW in 2005 in Crestone Creek and associated irrigation laterals on the Baca Refuge.

The Rio Grande chub occurs from Texas north through the Rio Grande and Pecos River drainages of New Mexico into southern Colorado (Rees et al. 2005a). In Colorado, this species is found in the Rio Grande basin in pools of small streams and creeks and in a few waters in the Gunnison Basin. The Rio Grande chub prefers streams with undercut banks, overhanging bank vegetation, and aquatic vegetation (Rees et al. 2005a). The spawning period for this species is primarily in the spring. This species was first documented in 2005 by CPW in Crestone Creek, Willow Creek, and associated irrigation laterals on the Baca Refuge. In 2013, it was proposed for listing under the Endangered Species Act. Visitor Services

We record between 15,000 and 20,000 visitor use days (table 14) per year on the refuge complex. Visitors enjoy a variety of recreational activities related to the six wildlife-dependent recreational uses—hunting, fishing, wildlife observation, photography, interpretation, and environmental education—that are identified in the Improvement Act as the priority uses. Service policy guides the management of wildlife-dependent recreational uses (FWS 2006e).

Our estimates of current visitation figures come from a variety of sources including traffic counters, physical counts of visitors who come through the headquarters, and special events.

This section discusses the priority public uses and other visitor-related activities we are involved with on the Monte Vista and Alamosa Refuges (FWS Refuge Annual Performance Planning database 2012c). The Baca Refuge is not open to the public.

Table 14. Visitor use days on the Monte Vista and Alamosa Refuges.

Wildlife observation	*Special events*	*Contact stations*	*Hunting*
Monte Vista National Wildlife Refuge			
6,850	7,000	700	400
Alamosa National Wildlife Refuge			
2,650	150	675	500

In 2011, USGS completed a visitor survey of visitors to the Monte Vista Refuge (USGS 2011b). Of 227 survey participants, about 56 percent had only been to the refuge once in the 12 months before, while 44 percent had been to the refuge multiple times. About 35 percent of the visitors lived within 50 miles of the refuge, and 65 percent were considered nonlocal. Nonlocal visitors travelled an average of 253 miles to the refuge, and 90 percent were from Colorado.

Surveyed visitors enjoyed a variety of refuge activities. The top three activities reported were birding (83 percent), wildlife observation (71 percent), and driving the auto tour route (60 percent).

Hunting

Hunting for waterfowl, upland birds, and small game is a popular activity on the Monte Vista and Alamosa Refuges. We estimate that 900 to 1,000 hunt visits occur annually. Waterfowl is the most frequently hunted game. Hunting is allowed in designated areas, and the refuge provides parking areas, informational kiosks, directional signage, accessible blinds, and vault toilets (see figures 13 and 14, chapter 3)

The waterfowl hunting season is busiest in early October. Starting in November, the wetlands freeze and birds move out of the valley. In the past, when waterfowl hunting at the refuges was in high demand, a refuge-specific hunt permit was required to limit the amount of hunters in the field. This improved hunter satisfaction with the experience and made it a safer environment. Since the extended drought began in the early 2000s, the refuges haven't been able to support as many fall migrating birds. Because there have been fewer birds, there has been less hunting pressure.

Fishing

In general, the shallow water in the refuge complex wetlands does not support a viable fishery. The Rio Grande does support a fishery, but because of several issues, including disturbance to other wildlife species, fishing has not been allowed. However, we host an annual Kid's Fishing Day event which is led by our Friends group at the Monte Vista Refuge during National Fishing Week. A pond (less than 2 acres in size) is stocked with trout donated by the Hotchkiss National Fish Hatchery. The event is geared toward teaching children how to fish. After the main event, children with special needs and senior citizens are allowed to fish the pond until it is dewatered, which usually happens within 2 to 3 weeks. The event reaches approximately 100 to 150 children every year. Local merchants donate more than $500 in prizes annually for this event. The Friends group donates lunch to all attendees.

Wildlife Observation and Photography

The Monte Vista Refuge is nationally known for large numbers of sandhill cranes during spring and fall migration, and many visitors come to the refuge to enjoy the spectacle. Visitors also enjoy watching other wildlife species in their native habitats, including ducks, white-faced ibis, black-crowned night-herons, Swainson's hawks, coyotes, and elk. Several parking areas offer excellent crane viewing, and an auto tour loop and short walking trail provide opportunities throughout the year to see other wildlife.

Visitors to the Alamosa Refuge can experience the unique wildlife and habitats that surround the Rio Grande. Species that are commonly seen along the Rio Grande Nature Trail at different times of the year include beaver, porcupine, bald eagle, yellow warbler, and the endangered southwestern willow flycatcher. The auto tour loop provides glimpses of many wetland-dependent bird species, including American bittern, Virginia rail, marsh wren, white-faced ibis, American avocet, and various waterfowl species. The Bluff Overlook provides a sweeping view of the refuge's wetlands and surrounding valley's mountainous horizon. Elk can sometimes be been seen from the overlook. The Bluff Nature Trail also gives visitors a chance to get out and walk or bike the trail though upland habitats that provide a beautiful late-summer display of native sunflowers.

Photography opportunities are limited to open public use areas on Monte Vista and Alamosa Refuges.

Interpretation

The Alamosa and Monte Vista Refuges provide self-guided interpretation through panels, brochures, and informational kiosks. The auto tour loop interpretive signs on the Alamosa Refuge and crane-specific panels on the Monte Vista Refuge are in poor condition. Both refuges share one general brochure, which limits opportunities to educate visitors about the different refuges. The Alamosa Refuge visitor center's educational resources are only available at times when volunteers are able to open the center, as the refuge complex does not have full-time interpretive staff. Interpretive talks are provided on an as-needed basis if staff or volunteers are available.

Environmental Education

We work with the Friends group to organize several educational events, including the Monte Vista Crane Festival, Kid's Fishing Day, and Kids Crane Festival. Environmental education programs are provided to a variety of groups, including teachers and students, on an as-needed basis. The Alamosa and Monte Vista Refuges have several site-specific educational activities that meet Colorado State Education Standards led by refuge staff, volunteers, our Friends group, and teachers.

Outreach

Limited outreach occurs through the local welcome centers, chambers of commerce, and other Federal agency visitor centers. Our website is out of date and needs to be updated and upgraded to current standards. At this time, because of limited refuge staff, we are unable to easily keep visitors updated with current conditions or wildlife sightings.

Commercial Recreation

Various types of commercial recreation that are compatible with the refuge complex's mission are allowed through a special use permit process. Typically, these are short-term requests for wildlife photography or filming.

Facilities and Staff for Visitor Contacts

The operations office for the refuge complex is located at the Lillpop office on Emperius Road in Alamosa. This building is unsatisfactory for many reasons: it is tucked away from visitors, vendors, and other people who may need information or services; it is not designed for an office environment; it is not universally accessible for members of the public or employees with disabilities; and it has poor ventilation, which is not conducive to a productive working environment. Current access to the building is from Emperius Road, which necessitates a blind railroad crossing with no gates, and which presents a major safety hazard for visitors and employees that is impossible to remedy.

Most refuge complex visitation occurs at the Monte Vista Refuge. The existing small refuge office is not designed to be a visitor contact station and is not capable of handling the visitation that occurs during the crane festival. Alamosa Refuge has a visitor contact station that is open part-time and is often staffed by volunteers. A new main office and visitor contact station is being built at the Baca Refuge.

We do not have an Outdoor Recreation Planner (staff person dedicated to providing visitor services). The potential for increased visitation to the refuges is enormous given their nearness to Alamosa, the largest community in the San Luis Valley. They are also within a few hours of the greater Denver area, Colorado Springs, and Santa Fe.

Roads and Access

On the Monte Vista Refuge, there are nearly 14 miles of roads that provide public access to facilities. Of these, several miles are county roads and Highway 15 that border or cross through the refuge in some way. There is a 2.5-mile auto tour route that visitors can drive nearly year round. There are about 9 miles of trails and roads that are available only during the hunting season. There is a 0.24-mile nature trail (see figure 13, chapter 3). In addition, there are a number of refuge roads that support habitat management activities on the refuge (figure 50).

On the Alamosa Refuge, there are about 18 miles of roads that provide access to refuge facilities. Of these, access to facilities occurs off several county roads that are open to the public. There is a 3.2-mile auto tour route that is graveled and open most of the year, weather permitting. There are 7 miles of trails that provide for access during the hunting season only and 2 miles of nature trails (see figure 14, chapter 3). In addition, there are a number of refuge roads that support habitat management or other activities on the refuge (figure 51).

On the Baca Refuge, there are about 9 miles of county roads that intersect or follow the boundary or provide a short access to the headquarters area. No other facilities are open to public access (see figure 15, chapter 3). There are a number of refuge roads that support other management activities on the refuge (figure 52) including the operation of BOR's Closed Basin Project.

Table 15. Public access on the Refuge Complex.

Monte Vista National Wildlife Refuge	
Miles of open roads along boundary or through refuge	14*
Miles of trails open during hunting only	9
Miles of nature trails (interpretive)	0.24
Miles of auto tour route open	2.5*
Alamosa National Wildlife Refuge	
Miles of open roads along boundary or through refuge	18*
Miles of trails open during hunting only	7**
Miles of nature trails (interpretive)	2
Miles of road closed except for hunting	3**
Miles of auto tour route open	3
Baca National Wildlife Refuge	
Miles of roads along boundary or through refuge	9
Miles of trails open for public use	0
Miles of nature trails open for public use	0
Miles of auto tour route for public use	0

**includes* refuge roads, State roads, or county roads that traverse through or along refuge boundary and are open year round

***these* roads are only open to hunters during hunting season

4.4 Human History and Cultural Resources

Humans have inhabited the San Luis Valley for more than 12,000 years. The following summary of the prehistory and history of the valley provides an overview of some of the major themes and events that illustrate the human interaction with the land. There is an abundance of prehistoric evidence, early historical accounts, photographs, and local histories for the valley.

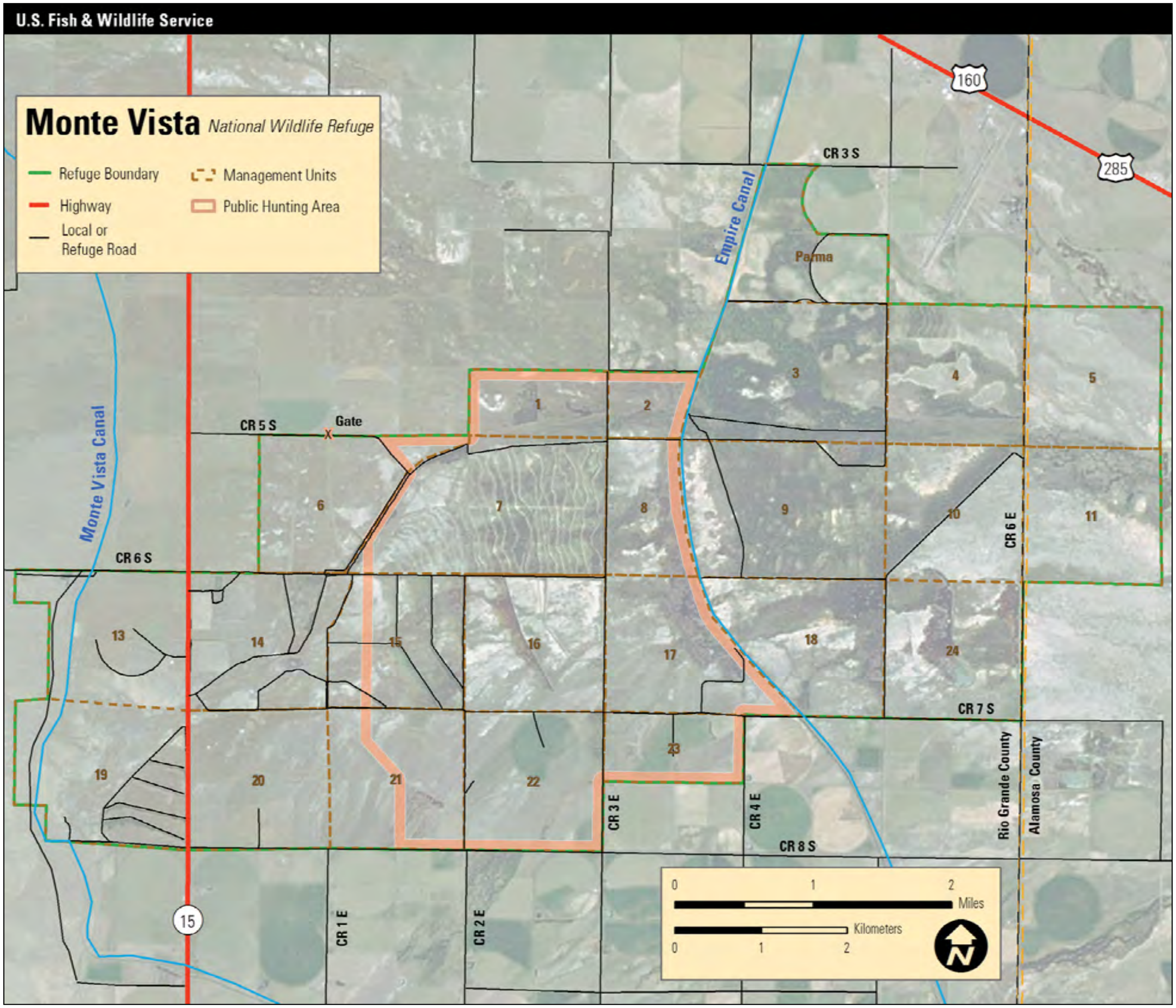

Figure 50. Roads and management activities on Monte Vista National Wildlife Refuge, Colorado.

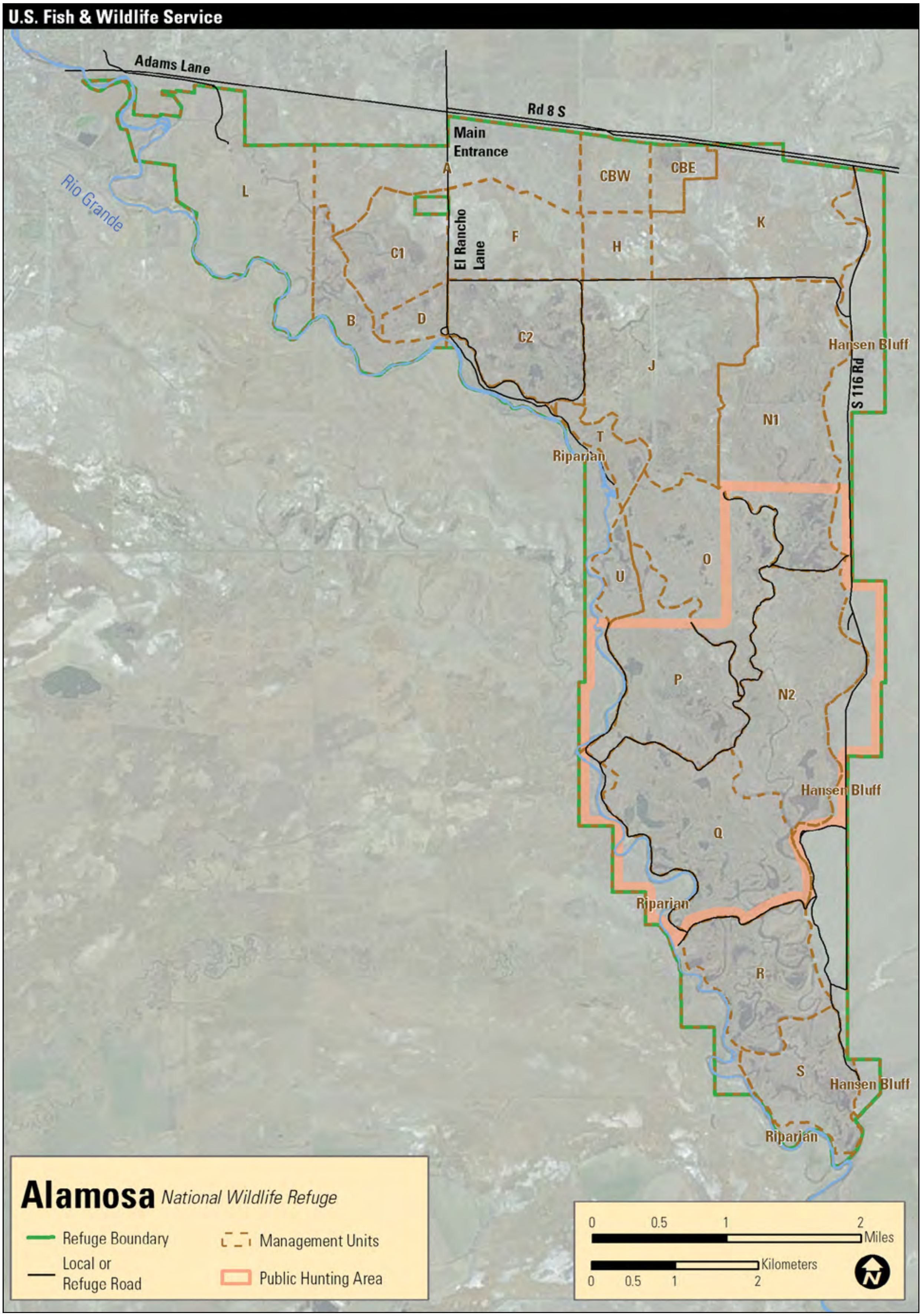

Figure 51. Roads and management activities on Alamosa National Wildlife Refuge, Colorado.

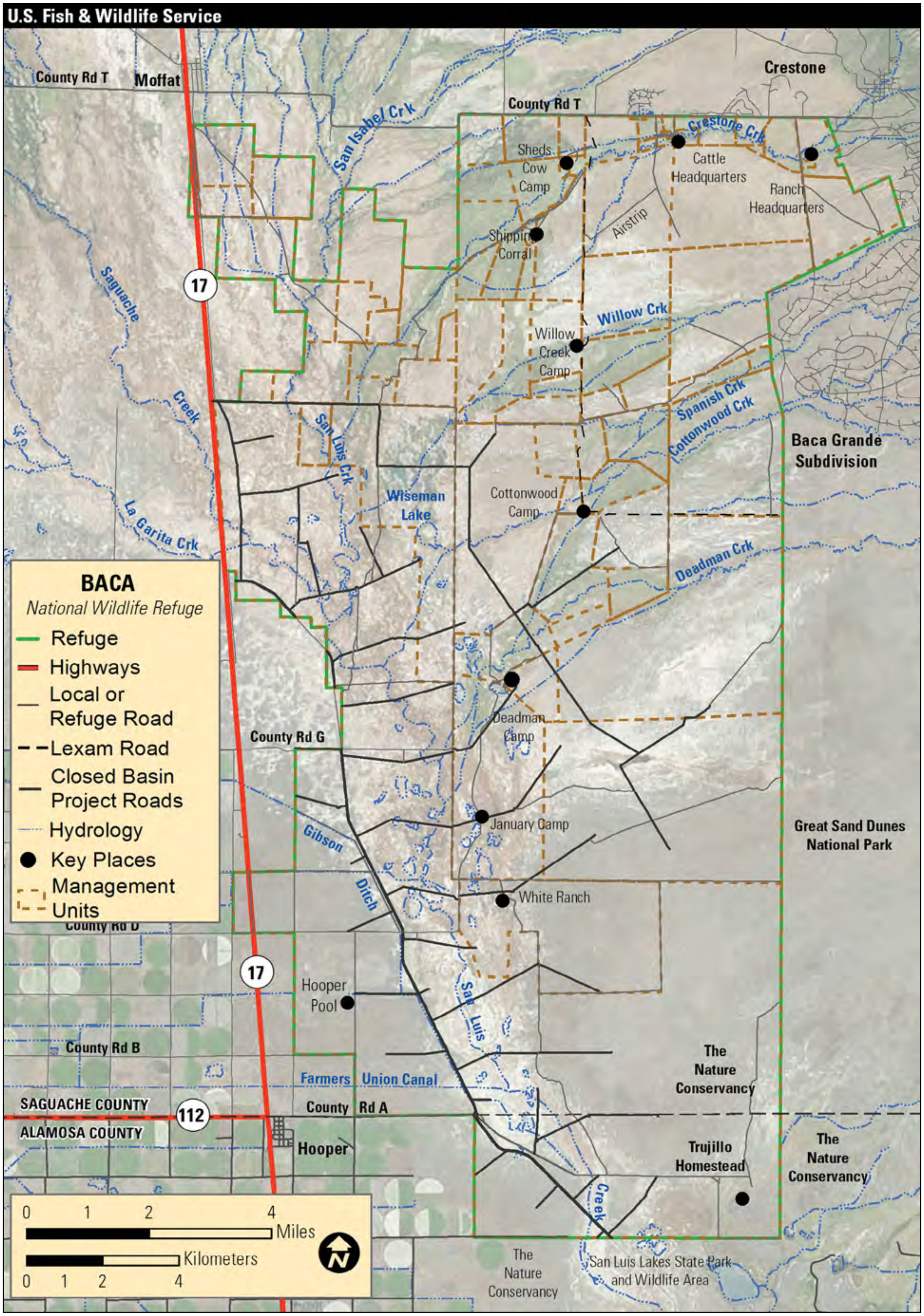

Figure 52. Roads and management activities on Baca National Wildlife Refuge, Colorado.

Prehistoric History

The prehistoric history is subdivided into the Paleoindian Stage, Archaic Stage, Late Prehistoric Stage, and Protohistoric Stages.

Paleoindian Stage

Current archaeological evidence indicates that the earliest humans, called the Paleoindians, migrated to the region near the close of the last Ice Age approximately 12,000 years ago. These people had highly mobile lifestyles that depended on the hunting of large, now-extinct mammals, including mammoths and the huge ancient bison *(Bison antiquus)* which are not the same species as the American bison *(Bison bison)*. The hallmark of most Paleoindian sites are the beautiful but deadly spear points that were launched with the aid of a simple yet expertly engineered spear-thrower called an atlatl. These projectile points are generally recovered as isolated occurrences or in association with animal kills, butchering sites, or small temporary camps. Although the timing of this stage varies throughout the region and is constantly being refined as more information becomes available, it lasted until about 7,500 years ago.

According to the Colorado Office of Archaeology and Historic Preservation, 62 Paleoindian archaeological sites or projectile points have been found within the San Luis Valley. These are often located near wetlands and along the shorelines of ancient lakes, reflecting the use of abundant plant and animal resources available in these locations. Several Paleoindian sites in the surrounding mountains have been excavated, including the high-altitude Black Mountain site (5HN55) located at 10,000 feet in the San Juan Mountains south of Lake City on the western edge of the San Luis Valley. This campsite dates from approximately 10,000 to 7,000 years ago and has yielded a variety of stone tools suggesting animal hunting and processing (Jodry et al. 1999a).

Several Paleoindian sites on the San Luis Valley floor have been excavated and provide an extensive record of the early occupations. Three of these sites, the Cattle Guard site (5AL101) (which is on NPS lands), the Linger site (5AL91), and the Zapata site (5AL90), are all located just south of Great Sand Dunes National Park and Preserve and represent camps with an abundance of bison bones and associated stone tools (Cassells 1997, Jodry et al. 1999a). The Reddin site (5SH77) near the town of Hooper yielded nearly 500 Paleoindian artifacts suggesting a variety of activities (Cassells 1997, Jodry et al. 1999a).

Climatic fluctuations during the Holocene Epoch, which started about 12,000 years ago and continues to the present, are often reflected in the archaeological record. Pollen remains, faunal assemblages, and geomorphological deposits suggest periods of significant and rather abrupt vegetation changes and variations in the amount of moisture (Jodry et al. 1999b, Martorano 1999a). Bison remains associated with archaeological sites on the Southern Plains also show that bison numbers rose and fell in response to climatic conditions (Creel et al. 1990). Although more research is needed and our ability to discover and interpret prehistoric artifacts and data is continually improving, the studies done thus far offer an intriguing look into the evidence for and consequences of long-term climatic change.

Archaic Stage

Human use in the region had a gradual but definite shift to a new stage that began about 7,500 years ago and continued until approximately 1,500 years ago. The changes were the result of a combination of regional climatic fluctuations, an increasing population, new technological innovations, and regional influences. Although this stage is better represented in the archaeological record than the preceding Paleoindian Stage, the identification and interpretation of the artifacts and remains continue to be expanded and refined. Evidence of a greater diversity of tools and the use of a larger variety of plants and animals is found on many sites.

There have been 618 Archaic Stage archaeological sites or points recorded in the Colorado portion of the analysis area. As with the earlier inhabitants, the Archaic peoples made extensive use of the valley's wetland resources, and occupied rock shelters and several other high-altitude locations found in the surrounding mountains. When speaking of Archaic sites in the northeastern valley, Hoefer et al. (1999) state: "Most of the Closed Basin archaeological sites are open camps containing debitage and fire-cracked rock scatters, approximately half of which contain ground stone implements such as metate fragments or manos. Many of these sites are located around seasonal wetland marshes and lakes." The use of the atlatl with spear points continues, and basketry, cloth, and cordage come into use. Although still highly mobile, the population increasingly makes short-term use of small groupings of structures with storage features. Hunting blinds and other rock structures are fairly common although often difficult to interpret. Archaic Stage rock art is scattered throughout the region and the influences of surrounding regions, particularly the Plains and the Great Basin, are identifiable at several sites.

Late Prehistoric Stage

Beginning approximately 1,500 years ago, several innovations greatly influenced life in the valley (Martorano 1999b). Although these changes were adopted at different rates and degrees throughout the area, the advent of pottery and the bow and arrow, coupled with a larger and more sedentary population, defines the period until approximately 600 years ago. Early archaeological research in the valley found numerous regional influences, with several sites exhibiting pueblo-inspired attributes (Renaud 1942). In 1694, Don Diego de Vargas documented his visit to the valley, thus providing an early written historical account and ushering in the historic period.

The 442 Late Prehistoric resources in the State's Office of Archaeology and Historical Preservation database are listed under a variety of designations for this stage but all date to about the same time period. The distribution of Late Prehistoric sites in the valley shows a continuation of the trend of intensive use of wetland habitats (Martorano 1999b). This is not surprising as the available resources—both floral and faunal—would have continued to be abundant in these areas. Site types include camps, stone tool scatters, rock art, rock alignments and enclosures, and quarries where the lithic material for stone tools was collected.

Protohistoric Stage

By the late 1600s, Spanish incursions into the valley were beginning to affect the lives of the native populations. The Utes, who, based on archaeological evidence, came to the valley sometime after A.D. 1100 (Reed 1994) and who were the most numerous occupants of the valley, quickly acquired horses and other trade items. Although many other Native American groups probably visited or traveled through the valley, the Comanche, Apache, Navajo, Arapaho, Cheyenne, and several northern Pueblos also had a significant if not sustained presence (Martorano 1999c).

There are 59 sites from this stage in the State's Office of Archaeology and Historical Preservation files, which include the traditional stone tools and ceramics mixed with utilized and flaked glass, trade beads, and metal projectile points. Wickiups (conical timbered structures) and trees with peeled bark indicating the harvesting of the edible cambium layer are found, as is rock art with motifs and depictions of post-contact goods.

Early History

The historical period for the valley began with the recurring contact of native peoples with people of European descent and ends in the mid-20th century. This interaction followed many years of occasional contact, often for the exchange of trade goods.

In 1598, the Spanish explorer and newly appointed Governor of New Mexico, Don Juan de Onate, claimed for Spain all lands, structures, and people along the Rio Grande—including the San Luis Valley—forever. This followed several years of sporadic Spanish incursions into northern New Mexico and southern Colorado and ushered in several decades of trade, conflict, and settlement. Many Spanish travelers used the Northern Branch of the Spanish Trail, which had both western and eastern routes through the valley. Although Spain lost ownership of the valley in 1821 when Mexico gained independence, Spanish influence survives as a vital part of the landscape and people today.

There are numerous other explorers and settlers who left a legacy of journals, maps, and other accounts of their time in the valley. The examples summarized below provide a glimpse into the types of information and insight available in these early accounts. Several other documents are available and offer a wide variety of historic and environmental information.

Don Diego de Vargas: 1694

The 1694 journal of Don Diego de Vargas survives as the earliest written account of the San Luis Valley. The journal is a wealth of information about the native peoples, topography, and environment (Colville 1995). After leaving Santa Fe, De Vargas followed the North Branch of the Spanish Tail northward, traveling east of the Rio Grande and entering the San Luis Valley just southeast of Ute Mountain. From there he continued north, crossing what would become the New Mexico–Colorado State line and paralleling the western side of San Pedro Mesa before heading west along Culebra Creek. Reaching the Rio Grande, he turned south and crossed the river about 5 miles south of the confluence with Culebra Creek. His return trip to Santa Fe took him along the Rio San Antonito on the west side of the Rio Grande, and he exited the valley on the west side of San Antonio Mountain (Colville 1995).

His six days in the San Luis Valley included contact, trade, and occasional skirmishes with the Yutas (Utes), confrontations with Taos Puebloans, and observations of large herds of bison and some "very large deer." This reference is the earliest known historical account of bison in the valley (Colville 1995), the last being a brief mention of bison by Juan Bautista Silva along the Rio San Antonio south of present-day Antonito in the spring of 1859 (Kessler 1998). During their travels, the use of sign language and smoke signals for communication is well documented, as is the need to be near water during the mid-summer travels.

Juan Bautista de Anza: 1779

Eighty-five years later in 1779, Juan Bautista de Anza, the Governor and Military Commander of New Mexico, left Santa Fe and headed north to quell the Comanche raids that were devastating Spanish settlements in the region. Traveling by night to avoid detection, de Anza followed the North Branch of the Spanish Trail along the eastern foothills of the San Juan Mountains through Poncha Pass, and then headed east to the plains near Pike's Peak. From there, he headed south along the foothills through the areas that would become Colorado Springs and Pueblo, fighting several successful battles with the Comanche. He concluded his campaign by crossing back into the San Luis Valley at Sangre de Cristo Pass (now La Veta Pass) and taking the eastern route of the North Branch of the Spanish Trail back to Santa Fe (Kessler 1998). He initially entered the San Luis Valley on August 19, 1779, and by September 4 of that year he re-entered the valley near Fort Garland on his return trip to Santa Fe.

Zebulon Montgomery Pike: 1807

Unlike the earlier Spanish explorers, Captain Zebulon Montgomery Pike entered the valley from the east, traveling west from St. Louis across Missouri, Kansas, and the plains of Colorado. Pike's mission was to map and describe the southern parts of the newly acquired Louisiana Purchase. Pike's journal in the days preceding the descent into the San Luis Valley often mentions seeing "a gang of buffalo," including in the Wet Valley (which is on the east side of the Sangre de Cristo Range), but there is no mention of bison after he enters the San Luis Valley. In contrast, deer are often mentioned in the San Luis Valley and goose was a part of at least one meal. Pike grew fond of the San Luis Valley and concluded that "...it was at the same time one of the most sublime and beautiful prospects ever presented to the eyes of man" (Hart and Hulbert 2006).

Jacob Fowler: 1821-1822

The 1821-1822 journal of Jacob Fowler, which *The New York Times* referred to as "quaint and interesting" (The New York Times 1898), is a wealth of information about the environment and the interactions between the various peoples who occupied the valley (Coues 1965). *The New York Times* further describes the journal—just published by noted ornithologist Elliott Coues—as "…a notable contribution to our knowledge of early adventure and pioneering in the Great West. His style is straightforward and his wonderful power of observation has made the narrative very attractive."

Fowler was a fur trader who entered the valley via La Veta Pass on February 4, 1822. For the next 3 months, he traveled between Taos and the center of the valley, going as far north as the area where Fort Garland would be later established. Many animals are noted in the valley, including beaver, elk, deer, bear, caberey (pronghorn), otter, big horned sheep, wild horses, geese, ducks, and a wolf. Although great herds of "buffelow" were noted on the Great Plains and as far west as the Wet Valley, there is no mention of them once they reach the San Luis Valley. As with the references to animals, the descriptions of plants, particularly the distribution (or lack) of cottonwoods and willows along specific creeks, is frequent and often detailed. These descriptions are mixed with accounts of life in the numerous small Spanish settlements that dotted the landscape as well as interactions with the native peoples.

Numerous other explorers and settlers visited the valley and left behind journals of varying detail (Hart and Hulbert 2006, Kessler 1998, Preuss 1958, Richmond 1990, Sanchez 1997). Among these are:

- George Frederick Ruxton, 1846
- John C. Fremont, 1848-1849
- Charles Preuss, 1848-1849 (traveling with Fremont)
- Gwinn Harris Heap, 1853
- John Williams Gunnison, 1853
- John Heinrich Schiel, 1853 (traveling with Gunnison)
- Randolph Barnes Marcy, 1858
- William Wing Loring, 1858
- Juan Bautista Silva, 1859

Political Boundaries, Land Grants, and Public Lands

The San Luis Valley has seen many changes in governance over the last 300 years. Following nearly 12,000 years of sovereignty by various Native Americans, control (or at least declared control) and the political boundaries of the region shifted continually until Colorado and New Mexico obtained statehood. The brief timeline below summarizes some of these changes in "ownership" of the San Luis Valley:

1598 Don Juan de Onate claims the San Luis Valley and surrounding areas for Spain.

1763 The Treaty of Paris at the end of the French and Indian War divides much of the North American interior between Spain and France. The San Luis Valley is considered Spanish territory.

1803 The Louisiana Purchase is negotiated between the United States and France, but the western boundaries are not clarified and remain ambiguous.

1819 The U.S. negotiates the Adams-Onis Treaty with Spain to clarify the boundaries of the Louisiana Purchase. The San Luis Valley remains part of Spain's New Mexico Territory.

1821 Mexican War of Independence (1810-1821). The San Luis Valley becomes a part of the new nation of Mexico.

1836 The Republic of Texas achieves independence from Mexico. Texas claims lands in the San Luis Valley, east and north of the Rio Grande. Mexico does not recognize the Republic, disputes this boundary, and continues to claim the entire valley.

1837 U.S. recognized the Republic of Texas, including the San Luis Valley.

1845 U.S. annexes Texas, including the San Luis Valley, and Texas achieves statehood.

1848 Following the Mexican-American War (1846–1848), the Treaty of Guadalupe Hidalgo establishes the present Mexico–United States border except for the later 1853 (southern Arizona and southern New Mexico).

1850 Texas surrenders its claim to New Mexico and the New Mexico Territory, including the San Luis Valley generally south of the Rio Grande (38th parallel), is established.

1854 Kansas Territory, which includes the northern part of the San Luis Valley (above the 38th parallel), is established out of previously unorganized lands of the Louisiana Purchase.

1861 Colorado Territory is created by the Colorado Organic Act with the same boundaries that would later become the State of Colorado.

1876 Colorado becomes a State.

1912 New Mexico becomes a State.

Numerous Mexican land grants were issued in the San Luis Valley as a direct result of the political turmoil noted above and the desire by Mexico City to keep control over the distant northern borderlands of their newly independent nation. These land grants were intended to encourage Mexican settlement in the borderlands, thereby dissuading any thoughts of Texas independence and discouraging encroachment by American fur traders.

The first grants consisted of numerous small parcels along the Conejos River in Colorado in 1833 (Athearn 1985, Simmons 1999). These small grants were ineffective in establishing permanent settlements, but the much larger 1842 Conejos Grant proved to have more success in persuading the founding and settling of farms and towns. The grant covered more than 2.5 million acres and included all of what would become the counties of Conejos and Rio Grande and parts of the counties of Mineral, Saguache and Alamosa. As with other Mexican land grants in the valley, the grants were considered invalid following the Mexican-American War. The Court of Private Land Claims in 1900 ruled against the grantees and negated the claim (Colorado State Archives 2001).

The Sangre de Cristo grant included all of what is now Costilla County and extended a short distance into the current State of New Mexico. The grant consisted of 1 million acres and was originally awarded to two Mexican nationals in 1844, but, following their deaths during the Pueblo Revolt of 1847, was sold to Charles (Carlos) Beaubien. Unlike the Conejos Grant, Charles Beaubien's claim to the land was upheld by the courts in 1860. The land was later sold to William Gilpin (Colorado's first territorial governor) in 1864. Large tracts of the grant have been sold to various developers, and disputes over the rights of local people to use the land continued through 2009 (Hildner 2009).

The Baca Land Grant was the result of a land dispute. The Baca grants, of which there are five, were granted to the heirs of Luis Maria Baca in replacement for his 1825 grant near Las Vegas, New Mexico, which was also claimed by Juan de Dios Maiese in 1835. These conflicting claims came to light when the U.S. took control of the lands in the mid-1840s. The Baca claim was settled in 1860 and patented in 1903, when the Baca heirs were given five parcels of land: two in New Mexico, two in Arizona, and one in the San Luis Valley, which was known as Baca #4. In various configurations and sizes, the Baca #4 lands changed hands many times over the next 100 years. Today, a large part of it makes up the Baca Refuge.

Native Peoples

The post-contact history of Native Americans in the San Luis Valley involves both cooperation and conflict and ends with the establishment of reservations outside of the valley. Although several Native American tribes are represented in the valley today, they are less than 4 percent of the current population (U.S. Census Bureau 2012).

The Utes (Yutas) consisted of several bands and at the time of contact were the primary Native American inhabitants of much of central and western Colorado, Utah, and parts of northern New Mexico. Increased Euro-American settlement after the United States gained possession of the valley in 1848 and the Gold Rush of 1859 brought new people to the valley and ushered in several decades of escalating pressure to remove the Utes (Ellis 1996). Fort Massachusetts (1852–1858) and Fort Garland (1858–1883) were established in the valley primarily to protect settlers from Ute attacks. The 1863 and 1868 treaties between the United States and the Utes gave parts of Colorado, including the San Luis Valley, to the United States. Over the next four decades, a series of treaties and agreements continued to reduce Ute lands and relocate the Ute peoples, with the eventual establishment of three reservations in southwestern Colorado and northern Utah by the early years of the 20th century.

Numerous other Native Americans visited or lived in the valley, including the Apache, Arapaho, Cheyenne, Comanche, Kiowa, and Navajo (NPS 2011b). Early historical accounts frequently mention various members of pueblos along the Rio Grande coming north into the central San Luis Valley to hunt bison, which caused occasional confrontations with the Utes (Carson 1998, Colville 1995). The first Pueblo revolt of 1680, a response to the expanding Spanish control in northern New Mexico, effectively ceased Spanish rule in the region until Don Diego de Vargas reestablished control over the pueblos in 1692 and 1696. The Taos Pueblo rebelled against the occupation of U.S. Troops during the Mexican-American War in 1847, but the rebellion was soon repelled, effectively ending major conflicts in the region.

Euro-American Settlement

Euro-American settlement of the San Luis Valley reflects cultural, economic, and political influences as well as creative adaptation to a unique environment. Slowly, following the establishment in 1610 of Santa Fe as the capital of the New Mexico province, explorers and traders made their way north into the central San Luis Valley. Jacob Fowler encountered several small Spanish settlements during his 1821–1822 travels north of Taos and into southern Colorado (Coues 1965).

The Catholic Church, which was a primary influence during the initial exploration of the region, continued to play a major role in the establishment of settlements and in the day-to-day lives of most of the inhabitants. Members of various church orders were often part of the early explorations, including the 22 Franciscans who accompanied de Onate during his 1598 exploration and settlement in northern New Mexico (Athearn 1989). The Church was instrumental not only in matters of faith, but also as educators, trade coordinators, keepers of public records, and builders of comparatively grand architecture. On the other hand, the oppressive condemnation and suppression of the Native religious practices was a major contributor to the unrest that led to the Pueblo Revolt of 1680 and the destruction of several missions. Nonetheless, the church began the 18th century as one of the only institutions to prosper, and soon missions were established throughout the region (Athearn 1989).

Early settlements in the valley were established based on the traditional pattern of the Spanish plaza with homes, churches, and public buildings clustered around a central square and long narrow fields radiating out around the buildings and fronting a nearby creek, sometimes referred to as cordillera or plaza farming (Colville 1995). The extensive systems of early irrigation canals and water control structures supported small grain fields and gardens and many elements are still in use today.

Several large canals and their associated laterals, including the Travelers Canal, the Empire Canal, and the Monte Vista Canal, were all built in the 1880s in response to the increasing demand for the valley's beans, corn, grains, and other vegetables and crops. The extensive irrigation in the valley was recognized early on as a source of future problems, as noted by Major John Wesley Powell in his 1890 testimony before the Senate Special Committee on Irrigation and Reclamation of Arid Lands:

> "Passing into New Mexico, then, the water that practically heads in the high mountains of Colorado is largely, almost wholly, cut off from the Rio Grande, so that no portion of the water that heads in these mountains where there is great precipitation will cross the line into New Mexico (in the dry season). In a dry season nothing can be raised in the lower region and sometimes the dry seasons come two or three together" (Siebenthal 1910).

The mining boom in the surrounding mountains in 1859, the completion of the Denver & Rio Grande Railroad over the Sangre de Cristo Mountains and into the San Luis Valley in 1877, and a vigorous advertising effort by land speculators led to a slow but steady increase in population in the latter half of the 19th century. Before the discovery of gold in 1859, the valley was the home of Colorado's largest non-Native American population, and by 1870, the population of Conejos, Costilla, and Saguache Counties is estimated to have been approximately 5,000 (Wyckoff 1999).

By the early 1870s, the effects of hunting and development were already taking a toll on Colorado's wildlife. In 1872, Colorado Territorial Governor Edward N. Cook passed the first game laws to protect certain birds, bison, deer, elk, and bighorn sheep (Colville 1995).

Summary of Known Historic Resources

Information about the recorded historic resources in the San Luis Valley is summarized from data obtained from the Colorado Office of Archaeology and Historic Preservation. Similar trends can be extrapolated for the parts of the area that are in New Mexico. These data represent the efforts of hundreds of agencies, organizations, and individuals to document and study the past. The counts include sites, buildings, structures, and isolated finds, bearing in mind that an individual resource may have many of these elements and may represent more than one time period and therefore be counted more than once. It is also important to note that cultural resources are often found where modern activities have mandated cultural resource surveys, and recorder bias may be a factor as much as actual prehistoric or historic settlement or use patterns.

The 4,091 historic components in the area include standing buildings or structures and historic archaeological deposits. Many of these are homes, commercial buildings, or public buildings within the towns in the valley, with 100 or more each recorded in Alamosa, San Luis, and Monte Vista. Rural sites with historical components often include water control structures (111 recorded), cabins or homesteads (68 recorded), roads or trails (62 recorded), and railroad-related features (28 recorded). The 1,635 historical archaeology components include isolated rubbish scatters and small features as well as artifacts or deposits associated with a building or structure.

USFWS\Van Ness

The Pedro Trujillo Homestead, located within the acquisition boundary on Baca Refuge, dates back to 1879-1902 and has been designated as a National Historic Landmark.

Two resources in the San Luis Valley have been designated as National Historic Landmarks. These include Pike's Stockade (5CN75) from 1808 and the Pedro Trujillo Homestead (5AL706) from the late 19th century. Approximately 100 cultural resources in the San Luis Valley are listed on the National or State Register of Historic Places. Another 435 resources are officially eligible to be listed on the National or State Registers but have yet to be formally nominated.

Native American Graves Protection and Repatriation Act

We have finalized a Memorandum of Understanding with our agency partners in the NPS, BLM, and USFS, as well as the Ute Mountain Ute Tribe, the Southern Ute Indian Tribe, the Jicarilla Apache Nation, the Uintah and Ouray Ute (the Northern Ute Tribe of Utah), the Pueblo of Zuni, the Navajo Nation, the Ohkay Owingeh (San Juan Pueblo), the San Ildefonso Pueblo, the Pueblo of Santa Ana, the Santa Clara Pueblo, the Pueblo of Laguna, the Cochiti Pueblo, and the Pueblo of Acoma for projects that require compliance with the Native American Graves Protection and Repatriation Act of 1990. Other tribes may be added to the agreement. The agreement addresses the treatment and disposition of all Native American human remains, associated and unassociated funerary objects, sacred objects, and objects of cultural patrimony which are defined as agency collections or are found as a result of an inadvertent discovery or intentional excavation on lands managed by all the agencies within the San Luis Valley.

All the agencies recognize the deep cultural and historic affiliation with the lands and resources held by all the Native American tribes that are party to the agreement. A variety of disturbances with respect to human remains could occur on lands managed by the agencies, including the refuge complex. These include natural processes such as sand blowouts, erosion, and animal activity; pedestrian foot traffic and various recreational activities; illegal digging and vandalism; surveys and inventories of sites; and fire suppression. The agreement provides for a process for notification to the tribes and repatriation of remains and sacred objects. The agencies agree to hold periodic government-to-government consultation meetings to address issues related to the agreement.

4.5 Socioeconomic Environment

Socioeconomic conditions in the area surrounding the refuge complex were analyzed with the help of the USGS through the Policy and Science Assistance Branch of the Biological Resources Division in Fort Collins, Colorado.

For CCP planning, the economic analysis provides a means of estimating how our current management (no-action alternative) and proposed management activities (action alternatives) would affect the local economy. This type of analysis provides two important pieces of information: 1) it illustrates the refuge complex's contribution to the local community, and 2) it can help in determining whether economic effects are or are not a real concern in choosing among management alternatives.

The economic value of the refuge complex isn't limited to the regional economy. The refuge complex also provides substantial nonmarket values (values for items not exchanged in established markets), such as protecting endangered species, preserving wetlands, educating future generations, and adding stability to the ecosystem (Carver and Caudill 2007). However, quantifying these types of nonmarket values is beyond the scope of this study.

This report first provides a description of the local communities and economy near the refuge complex. In section 5, the methods used to conduct a regional economic impact analysis are detailed, followed by an analysis of the final CCP management strategies that could affect stakeholders, residents, and the local economy. The management activities of economic concern in this analysis are:

- Revenue sharing payments
- Refuge complex staff salary spending
- Refuge complex purchases of goods and services within the local economy
- Spending in the local economy by visitors to the refuges

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Biologists perform work on the Baca Refuge.

Regional Economic Setting

The regional economic setting for the CCP includes the three national wildlife refuges: Alamosa Refuge, Monte Vista Refuge, and Baca Refuge. The combined area of the three refuges is roughly 112,801 acres (FWS 2013a). Alamosa, Costilla, Rio Grande, and Saguache counties make up the economic study area of the refuge complex. Collectively, these four counties have a population of 37,059 people and a total area of about 6,031 square miles (U.S. Census Bureau 2010).

Population

Table 16 shows the population estimates and trends for the counties in the San Luis Valley. In 2010, Alamosa County accounted for approximately 0.3 percent of Colorado's population, while Costilla, Rio Grande, and Saguache Counties accounted for approximately 0.1 percent, 0.2 percent, and 0.1 percent, respectively (U.S. Census Bureau 2010). While Colorado's population grew 16.9 percent from 2000 to 2010, Alamosa and Saguache Counties grew by only 3.2 percent. Costilla and Rio Grande Counties experienced a decrease in population, declining by 3.8 percent and 3.5 percent, respectively (U.S. Census Bureau 2010).

Ethnically, each of the four counties in the study area has a relatively higher percentage of people identifying themselves as Hispanic or Latino than Colorado's overall figure of 20.7 percent. As a percentage of the population within each county, 45.3 percent in Alamosa County, 64.7 percent in Costilla County, 43.8 percent in Rio Grande County, and 39.4 percent in Saguache County identify themselves as Hispanic or Latino (U.S. Census Bureau 2010).

Racially, Colorado has a percentage of the population identifying themselves as being of White ancestry that is comparable to the four counties in the study area. Colorado's percentage of the population that identifies as White is 88.1 percent, while in Alamosa, Costilla, Rio Grande, and Saguache Counties, 88.7 percent, 89.5 percent, 94.0 percent, and 93.2 percent self-identify as White, respectively (U.S. Census Bureau 2010). These four counties have a lower percentage of the population identifying themselves as Black or African-American than the State of Colorado. The percentage of the population in Colorado that self-identifies as Black or African-American is 4.3 percent, while in Alamosa, Costilla, Rio Grande, and Saguache Counties, the percent of population that self-identifies as Black or African American is 1.6 percent, 1.4 percent, 0.6 percent, and 0.6 percent, respectively (U.S. Census Bureau 2010).

Income, Employment, and Education

Table 17 gives the median household income, unemployment rate, percentage of the population living below the Federal poverty line, and percentage of the population with a Bachelor's degree or higher for each county in the study area. The population within the study area is relatively less affluent than the State of Colorado or the nation. According to the U.S. Census Bureau, each of the four counties in the study area had a median annual household income level lower than both the State of Colorado ($57,685) and the U.S. ($51,914). Of the four counties, Alamosa County had the highest median household income at $38,299 per year, while Costilla County had the lowest at $25,949 per year (2010).

From 2009 to 2011, each of the counties in the study area except for Alamosa experienced an increase in the unemployment rate (U.S. Census Bureau 2010). With the annual U.S. unemployment rate in 2011 at 9.0 percent, the Colorado unemployment rate remained relatively lower at 7.6 percent (U.S. Department of Labor, Bureau of Labor Statistics 2012). Conversely, each county in the study area had unemployment levels higher than the national average in 2011, with Alamosa, Costilla, Rio Grande, and Saguache Counties experiencing unemployment rates of 9.5 percent, 10.8 percent, 11.0 percent, and 12.5 percent, respectively (American Community Survey U.S. Census Bureau 2012).

The percentage of Colorado's population with a Bachelor's degree or higher is greater than the national average (36.3 percent compared with the national rate of 27.9 percent). Each of the four counties in the study area, however, has a percentage of the population with a Bachelor's degree or higher that is below the national average, with the highest percentage being Alamosa County at 24.7 percent and the lowest being Costilla County at 15.3 percent (U.S. Census Bureau 2010).

Table 16. Population of counties in the San Luis Valley, Colorado.

	Population (2010)[a]	*Persons per square mile (2010)*[a]	*Percent population change (2000-2010)*[a]	*Projected percent population change (2010-2040)*[b]	*Median age (2010)*[a]
Colorado	5,029,196	48.5	16.9	54.1	36.1
Alamosa County	15,445	21.4	3.2	65.8	32
Costilla County	3,524	2.9	-3.8	25.1	46.8
Rio Grande County	11,982	13.1	-3.5	36.4	41.2
Saguache County	6,108	1.9	3.2	49.5	43.1

Sources:
[a]U.S. Census Bureau 2000, U.S. Census Bureau 2010
[b]Colorado Department of Local Affairs 2012

Table 17. Income, unemployment, and poverty statistics.

	Median household income (2010)[a]	*Percentage of population with Bachelor's degree or higher (2010)*[a]	*Persons below poverty level, (2010)*[a]	*Unemployment Rate*[b]	
				2009	*2011*
United States	$51,914	27.9	13.8	7.2	9.0
Colorado	$57,685	36.3	12.5	6.2	7.6
Alamosa County	$38,299	24.7	21.7	10.7	9.5
Costilla County	$25,949	15.3	22.2	8.1	10.8
Rio Grande County	$37,885	19.2	17.3	10.3	11.0
Saguache County	$33,672	20.1	25.3	99.6	12.5

Sources:
[a]U.S. Census Bureau 2010
[b]American Community Survey, U.S. Census Bureau 2012

Though only 12.5 percent of people in Colorado are living below the poverty level, which is less than the national average of 13.8 percent, each of the four counties in the study area has a percentage of people living below the poverty level that is higher than the national average. Saguache has the highest percentage of the population living below the poverty level in the four-county study area: 25.3 percent. Though still above both the State and national average, Rio Grande County has the lowest percentage of the population living below the poverty level within the study area: 17.3 percent (U.S. Census Bureau 2010).

Table 18 shows the percent employment by sector within the four-county area. More than 22,000 people were employed in the four-county area in 2011 (Bureau of Economic Analysis 2012). Farm employment accounted for nearly 9 percent of the workforce. The highest percentage of total employment, 19.3 percent, was found in the government and government enterprise sector. This sector has both local and non-local government agencies. The second and third highest percentage of total employment was in retail trade (9.7 percent) and accommodation and food services (5.7 percent). Please note that many employment estimates were not provided to avoid disclosure of confidential information.

Agriculture and Livestock

Agricultural sales estimates are presented in table 19. The State of Colorado is a productive region for both crops and livestock. In 2007, Colorado had an agricultural output of more than $6 billion, with crop output contributing nearly $2 billion and livestock output contributing more than $4 billion. The top five commodities produced in the State were layers (hen egg production), cattle and calves, wheat, forage, and corn (USDA 2007).

As of the 2007 Census of Agriculture, the four-county area was home to 1,189 farms, with 1.04 million acres in agriculture (USDA 2007). In 2007, within the four-county area, Rio Grande County had the greatest number of farms (390 farms) and Costilla County had the most acreage in production (401,147 acres). Costilla County also had the fewest number of farms (241 farms), and Alamosa County had the least acreage in production (176,629 acres) (USDA 2007).

The four counties in the study area are relatively agriculturally productive, with a combined gross annual agricultural output in 2007 of nearly $295 million, of which $265 million was the market value of crops and $30 million was the market value of livestock (USDA 2007). With regard to sales of the commodity group "vegetables, melons, potatoes, and sweet potatoes," Saguache, Rio Grande, Alamosa, and Costilla ranked first, second, fourth, and fifth, respectively, out of the 64 counties in Colorado (USDA 2007)

Table 18. Employment by sector.

Industry	*2011*	*Percent of total*
Total employment	22,062	
Wage and salary employment	15,502	70.3
Proprietors employment	6,560	29.7
Farm proprietors employment	1,033	4.7
Nonfarm proprietors employment	5,527	25.1
Farm employment	1,937	8.8
Private (non-farm) employment	20,125	91.2
Forestry, fishing, and related activities	0	0.0
Mining	0	0.0
Utilities	158	0.7
Construction	1,189	5.4
Manufacturing	405	1.8
Wholesale trade	647	2.9
Retail trade	2,131	9.7
Transportation and warehousing	572	2.6
Information	164	0.7
Finance and insurance	861	3.9
Real estate and rental and leasing	699	3.2
Professional, scientific, and technical services	635	2.9
Management of companies and enterprises	0	0.0
Administrative and waste management services	56	0.3
Educational services	41	0.2
Health care and social assistance	123	0.6
Arts, entertainment, and recreation	227	1.0
Accommodation and food services	1,265	5.7
Other services, except public administration	952	4.3
Government and government enterprises	4,253	19.3
Federal, civilian	344	1.6
Military	101	0.5
State and local	3,808	17.3

Source: Bureau of Economic Analysis 2012

Table 19. Market value of agricultural products sold, employment in agriculture.

	Total value of ag. products sold, in $1,000 (2007)	*Value of crops sold, in $1,000 (2007)*	*Value of livestock sold, in $1,000 (2007)*
Colorado	$6,061,134	$1,981,399	$4,079,735
Alamosa County	$91,413	$86,046	$5,367
Costilla County	$26,660	$22,840	$3,820
Rio Grande County	$85,360	$78,057	$7,302
Saguache County	$91,456	$78,536	$12,920

Source: USDA Census of Agriculture 2007

Recreation and Tourism

Angling, hunting, and wildlife viewing are popular recreational activities across Colorado and within the four-county area. According to the recent 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, approximately 2.3 million residents and nonresidents enjoyed wildlife-associated activities in Colorado (DOI, FWS, Department of Commerce, U.S. Census Bureau 2011). For the purpose of the National Survey, wildlife watching is categorized as follows:

- away-from-home (activities taking place at least 1 mile from home)
- around-the-home (activities taking place within 1 mile from home)
- All visitors to the refuge that engage in wildlife watching are considered away-from-home participants.

Of all participants, 40 percent identified as hunters or anglers, and 70 percent reported engaging in wildlife-watching activities. The number of hunting days by both residents and nonresidents totaled 2.2 million, with residents of the State of Colorado accounting for 71 percent of hunting days. The number of fishing days by residents and nonresidents totaled 8.4 million, with Colorado residents accounting for 89 percent of fishing days. In 2011, residents and nonresidents spent 6.9 million days watching wildlife away from home, with residents accounting for 69 percent of wildlife watching days. The in-State spending associated with all wildlife recreation totaled $2.98 million in 2011, with $1.24 million spent on trip-related expenditures, $1.56 million spent on equipment, and $189,000 spent for other items (DOI, FWS, Department of Commerce, U.S. Census Bureau 2011).

Economic Importance of Water

The refuge complex holds several water rights within the Rio Grande hydrologic system. Water in the San Luis Valley has largely been decreed to be used for irrigation purposes. Water is highly valued for agriculture in the area, but it is also a vital element for wildlife habitat. The refuge complex uses much of its water to provide crucial habitat for wildlife, including wet meadow, playa wetland, riparian areas, desert shrubland, grassland, and cropland. These diverse habitats within the refuge complex support songbirds, water birds (including sandhill cranes), raptors, mule deer, and coyotes.

Though the water used by the refuge complex may not directly contribute to the agricultural economy of the study area, many of the visitors to the refuge complex come to observe the wildlife that is drawn to the artificial wetlands on the refuges. As described above and in chapter 5, these visitors have a positive economic effect on the local area and contribute to the overall economy of the region.

4.6 Special Management Areas

Sangre de Cristo Conservation Area

The Sangre de Cristo Conservation Area is a unit of the Refuge System and is part of the refuge complex. (Refer to figures 4 and 6.) It is in central southern Colorado and northern New Mexico, and it includes the San Luis Valley, the adjoining Sangre de Cristo Mountains, and the Sangre de Cristo's tributaries to the Rio Grande between Blanca Peak and the watershed of Costilla Creek. Within this project boundary, we will strategically find and acquire from willing sellers a proper interest in upland, wetland, and riparian habitats on privately owned lands (FWS 2012b). We plan to buy or receive donated conservation easements on those identified areas within the project boundaries, and would consider accepting donated fee-title lands as well. In total, the project calls for protection of 250,000 acres of uplands, wetlands, and riparian areas through conservation easements (FWS 2012b). Management of the conservation area does not directly affect management of the three national wildlife refuges; however, it protects a diverse array of plant communities, ranging from rabbitbrush shrub and sagebrush on the valley floor to alpine tundra and scree fields on the peaks of the surrounding mountains. These habitats are crucial for breeding and migratory birds and provide important opportunities for persistence and reintroduction of species that are protected under the Endangered Species Act.

San Luis Valley Conservation Area

Similar to the Sangre de Cristo Conservation Area, the proposed San Luis Valley Conservation Area seeks to protect the remarkable ecological values of the San Luis Valley largely through the acquisition of conservation easements. It could include limited acquisition of fee-title lands. (Refer to figures 4 and 6.)

Sangre De Cristo National Heritage Area

The refuge complex lies within the Sangre de Cristo National Heritage Area, which was established on March 30, 2009 in Public Law 111-11 for the “protection, enhancement, and interpretation of the natural, cultural, scenic, and recreational resources of the Heritage Area” (see figure 6). Heritage areas present opportunities for residents and visitors to recognize and celebrate a region’s cultural and natural values. The heritage area encompasses more than 3,000 square miles of the upper headwaters of the Rio Grande (NPS 2012b).

Other Jurisdictions

As discussed under water resources above, BOR is authorized by Public Law 92-514 (October 20, 1972) to operate and maintain the Closed Basin Project in parts of the San Luis Valley (including both the Alamosa and Baca Refuges) for the transport of water into the Rio Grande for the fulfillment of the United States’ obligation to Mexico and for furnishing water downstream of Alamosa for deficient areas of Colorado, New Mexico, and Texas. This is accomplished through direct diversion of water out of the Closed Basin system. BOR operates hundreds of wells on the Alamosa and Baca Refuges, which are accessed by a network of gravel and two-track roads

Chapter 5—Environmental Consequences

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Sunset from Monte Vista Refuge.

This chapter summarizes and compares the potential effects of implementing the four proposed management alternatives on the physical and biological environment, special area designations, public use opportunities, cultural and paleontological resources, and other social and economic factors. The environment that would be affected by these alternatives is described in "Chapter 4—Affected Environment."

5.1 Analysis Method

Under each resource topic, the actions that could affect that resource are discussed. For the most part, these are the actions stemming from the objectives and strategies identified in "Chapter 3—Alternatives." Often the effect of an action cuts across several resources. For example, increased visitor use may be beneficial to the local economy but have a negative effect on sensitive wildlife species.

We evaluated the potential environmental effects at several levels, including whether the effects are beneficial or negative (or "adverse" when describing threatened or endangered species or cultural resource impacts). We describe whether the effects are direct, indirect, or cumulative with other independent actions. We discuss the duration of an effect and whether it is over the long term or short term.

Direct effects are those for which the effect on the resource is immediate and is a direct result of a specific action or activity. Examples of direct effects include the effect of ungulate grazing on vegetation and the effect of hunting on wildlife.

Indirect, or secondary, effects are those that are induced by conducting specific actions, but occur later in time or are farther removed from the place of action through a series of interconnected effects. Examples of indirect effects include upstream surface disturbance leading to impairment of downstream water quality, or building a road that leads to the spread of invasive plants.

A cumulative effect is defined as "the impact on the environment which results from the incremental impact of our actions when added to other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). At the end of chapter 3, we described the reasonably foreseeable actions that are independent of the actions in the CCP but that could result in cumulative effects.

We have used the following general guide to describe potential effects in terms of their context, intensity, and duration:

- Negligible—the effect, whether negative or beneficial, would be at the lower levels of detection (less than a 5 percent change compared to existing conditions).
- Minor—the effect, whether negative or beneficial, would be detectable or noticeable (a change of 5–24 percent).
- Moderate—the effect, whether negative or beneficial, would be clear, and would have the potential to become major (a change of 25–50 percent).
- Major—the effect would be severe, or if beneficial, would have exceptional beneficial effects (a change of more than 50 percent).
- We describe the potential effects as occurring over the short term or long term. Short-term effects typically describe what would happen during a period of 1–5 years. For example, there could be a short-term disturbance to vegetation from prescribed fire. Long-term effects would last at least 5 years after project initiation, and may outlast the 15-year life of the CCP. For example, there could be a long-term improvement to wildlife habitat resulting from a short-term effect such as a prescribed fire.

Under each resource, the potential effects that are common to all alternatives are discussed first. This is followed by a discussion of specific subtopics that are related to the resource. If the topic is short, all the alternatives are discussed together, but where there are distinct differences between the alternatives, they are broken out by alternative.

In compliance with the provisions of the Improvement Act, we have made a thorough assessment of the potential environmental effects using available science, which is consistent with NEPA and Department of Interior and Service policies. Wherever possible, the degree of effect is quantified using known numeric information or modeled estimates, or where extensive research provided pertinent numeric information. We used GIS data that were provided from several sources, including other agencies, organizations, and researchers, to evaluate and make measurements; these sources are identified. Although GIS is a useful tool for evaluating and answering questions, it is not the same as a formal land survey and discrepancies can exist. Where sufficient numeric information was not available, we used qualitative or relative assessments using scientific literature or professional field experience.

The analysis of potential environmental consequences is found in the following six sections of this chapter:

- 5.4 Environmental Consequences for the Physical Environment
- 5.5 Environmental Consequences for Biological Resources
- 5.6 Environmental Consequences for Visitor Services
- 5.7 Environmental Consequences for Special Areas
- 5.8 Environmental Consequences for Cultural and Historical Resources
- 5.9 Environmental Consequences for the Socioeconomic Environment

The Service also analyzed the following topics, as documented in these sections:

- 5.10 Irreversible and Irretrievable Resource Commitments
- 5.11 Short-Term Uses of the Environment and Maintenance of Long-Term Productivity
- 5.12 Adherence to Planning Goals
- 5.13 Unavoidable Adverse Effects
- 5.14 Conflicts with Federal, State, Tribal, and Local Agencies

5.2 Assumptions

We made our assessments based on a variety of information, including meetings and other communications with natural resource and other professionals, published scientific information, site inventorying, agency reports, staff knowledge, and computer modeling. We made the following assumptions in the analysis presented in this chapter:

Money and staff would be sufficient to carry out any alternative selected. This does not constitute a commitment for funding, and future budgets could affect implementation.

Inventory programs would be carried out and inventory activities would be conducted a minimum of once every 5 years, and adjustments or revisions (within the scope of the particular alternative) may be made to management actions as shown by evaluations.

Standard operating procedures would be followed.

This CCP would be reviewed at 15 years, or sooner if needed.

5.3 Cumulative Impacts

Following the discussion of direct and indirect effects, at the end of each topic, the expected cumulative impacts of each alternative and the reasonably foreseeable actions are discussed. Reasonably foreseeable actions are described near the end of "Chapter 3—Alternatives."

The cumulative effects discussion focuses on four broad categories of reasonably foreseeable actions:

- Federal land management activities
- State wildlife management
- nongovernmental conservation activities
- regional demographic and economic changes

5.4 Environmental Consequences for the Physical Environment

The following sections discuss the effects of implementing the alternatives on the following parts of the physical environment: climate change; air quality; soils; water resources; visual resources and night skies; and soundscapes. Potential cumulative impacts are also considered.

Climate Change

The potential effects of the Service's actions with respect to influencing climate change at a global level are addressed in this section. The likely effects of climate change on the refuge complex's habitat and wildlife resources are addressed in the section discussing the biological environment.

All Alternatives

The refuge complex would implement Department of Interior and Service policies on climate change, including adaptation, biological planning, landscape conservation, research, energy efficiency, collaborating with other partners, and educating the public through visitor services programs. These would be achieved by adopting specific objectives and strategies in our habitat management and visitor services programs. (Refer to the climate change sections in chapters 1 and 3 for a complete discussion.)

By their nature, wildlife refuges protect large areas of vegetated lands and wetlands that are important for potential carbon sequestration and for preserving carbon that is now sequestered in soils and vegetation (U.S. Department of Energy 1999). The refuge complex has 100,000 acres of protected fee-title lands. These lands do not include the Sangre de Cristo Conservation Area or the proposed San Luis Valley Conservation Area. Over the long term, our habitat management actions under any alternative would continue to protect the vegetation found within the refuge complex. We would also work with the State and others to manage water sustainably.

Our current estimated visitation is between 15,000–20,000 visitor use days per year, but estimates of visitors per vehicles or any potential increased carbon emissions from carrying out the alternatives is unknown. However, many visitors participate in activities such as hunting, birding, and other wildlife-dependent activities that do not depend on vehicles; during the Monte Vista Crane Festival, buses are used for tours. In a winter-spring survey of visitors to the Monte Vista Refuge, USGS (2011b) found that 91 percent of visitors who travelled to the refuge were in a private vehicle, as part of a group on their visit to the Monte Vista Refuge. About 35 percent of visitors surveyed lived in the local area (within 50 miles of the refuge) and about 90 percent travelled to the refuge from within the State of Colorado. We don't know how many visitors would travel to the refuges as part of their overall visit to the San Luis Valley.

In large part because the Baca Refuge would be opened to public use, alternatives B and D would result in more visitors and more vehicles driving on refuge roads over the long term. For the Monte Vista and Alamosa Refuges, we estimate that visitor use days would increase by 10–15 percent under alternative B and by 25 percent or more under alternative D. Alternative C would be similar to alternative A, but it could result in fewer visitors coming to the Monte Vista Refuge because changes in our water and habitat management could affect wildlife viewing opportunities. Opening the Baca Refuge under alternatives B and D would result in an estimated 1,000–3,000 visitors coming to the refuge. As better facilities and structures were added, we would expect to see visitation increase gradually to 10,000–15,000 visitors per year to the Baca Refuge. In comparison, the nearby Great Sand Dunes National Park and Preserve reports an average of 276,375 recreational visits annually (NPS 2012a).

Under all alternatives, we would seek ways to reduce our energy consumption and carbon footprint. These include building energy-efficient offices and a visitor contact station at the Monte Vista Refuge, driving more fuel-efficient and cleaner vehicles, and promoting activities such as walking and biking.

Implementation of all alternatives would result in negligible effects on climate change.

Effects on Air Quality

In this section, we describe the potential effects on air quality of several sources of emissions, including increased use of motorized vehicles and equipment as well as the use of prescribed fire.

All Alternatives

Implementation of all alternatives would result in varying levels of motorized equipment use for activities such as construction of public use facilities, habitat restoration, and ongoing refuge management. Under every alternative, these activities would result in negligible short-term increases in dust, carbon monoxide, and hydrocarbons. (Refer to table 9 in chapter 4, section 4.2.) Negative effects could be mitigated by applying best management practices to reduce dust emissions.

Prescribed fire would be used under all alternatives. All prescribed fires follow specific burn plans that are carried out under an approved interagency fire management plan (NPS, FWS, TNC 2006) and comply with all regulations and guidelines established by the Colorado Department of Public Health and Environment (Air Pollution and Control Division). Prescribed fires and wildfires can increase dust and ash after a fire. Strong winds blow dust and ash, usually within a short period of time following a wildland fire, but blown dust and ash can go on longer during drought conditions where vegetation takes longer to recover. Under alternative A, on average, we would continue to conduct 2–3 prescribed fires annually, averaging <600 acres each. Under the action alternatives, this would not be expected to change significantly; therefore, regardless of the alternative selected, increases in carbon emissions from prescribed fire would be negligible.

Under all alternatives, the Class II air quality of the refuges would remain protected. None of the alternatives would negatively affect nearby Class I areas.

Effects of Motorized Equipment and Vehicles

Some effects are common to all alternatives and some are specific to particular alternatives.

All Alternatives

For all the refuges, emissions, including dust, carbon monoxide, and hydrocarbons, would occur to varying degrees under all the alternatives. Since nearly all the roads within the refuge complex are gravel or dirt, road travel would generate and disperse dust particulates in levels that would vary depending on soil moisture content, particle size, traffic speed, time of year, and traffic volume (Havlick 2002). Dry or windy periods may exacerbate dust. Road access would be limited during some periods of the year when weather conditions preclude use. Travel would be nearly nonexistent at night except for on county roads that border one of the refuges.

Alternative A

Under this alternative, there would be no new roads or trails open for public access on any of the refuges, and the roads that are available for public access or viewing opportunities would remain the same. (Refer to table 21 under the Visitor Services section below and figures 13, 14, and 15). Most of the trails on the Monte Vista and Alamosa Refuges would be open only during the waterfowl and small game hunting seasons. Baca Refuge would only be open for limited guided tours. The 2.5-mile auto tour route on the Monte Vista Refuge and the 3.2-mile auto tour loop on the Alamosa Refuge would remain open year round for all visitors. Visitation would not be expected to change, nor would there be increased activities related to other refuge operations. (Refer to table 14, chapter 4.) Emission levels would not change to any degree, and emissions levels from all sources would have a negligible effect on air quality.

Alternative B

For the Monte Vista and Alamosa Refuges, a primary change from alternative A is that most of the existing trails or roads that are open only to hunters during the hunting season would be available to all visitors from July 15–February 28 for walking and biking, which would increase visitor use on the refuges. Since the existing auto tour route would be connected to the Bluff road, there would be a little more than 2 more miles of auto tour route on the Alamosa Refuge. This would reduce the number of miles that visitors would need to travel to access Bluff Overlook.

When the Baca Refuge is fully opened to public use, there would be about 14 miles of year-round auto tour route plus a seasonal option of about 6 miles. These roads would be gravel, and access would be seasonal. Visitation would be expected to increase slowly over the long term.

Building a new visitor center and refuge headquarters at the Monte Vista Refuge would increase the Service's visibility and draw more visitors to the refuge, particularly during the spring and fall crane migration.

Across the refuge complex, visitor use days would be expected to increase over the long term by a moderate amount (15–25 percent) on the Alamosa and Monte Vista Refuges. More than 15,000 visitors a year would be expected to visit the Baca Refuge, which is now closed to public use. Many visitors would use the refuges for walking, biking, hiking, or hunting, in addition to driving the auto tour routes. The speed limits along the auto tour routes would remain low (less than 30 miles per hour), and visitation would be seasonal. There would continue to be restrictions in place during the nesting season (spring to early summer), which may limit access to the refuges during these periods. Emissions levels from all sources would result in negligible effects on air quality.

Other refuge activity, such as habitat restoration and construction of a new visitor center, could increase emissions over the long term. Most of the increased emissions would occur for short periods of time (from a few hours to a few weeks), but may last as long as several months when the new visitor center is built.

Overall, the long-term impact on regional air quality would be negligible.

Alternative C

There would be a few more miles of roads available for public access on the three refuges. Visitation to the Monte Vista and Alamosa Refuges might be similar to what would take place under alternative A. If wildlife viewing opportunities decreased, however, visitation could be lower than under alternative A. Similar to alternative B, all visitors would be able to access trails for walking and biking on the Monte Vista and Alamosa Refuges from July 15 to February 28. The Baca Refuge would be opened primarily for hunting access.

Habitat management operations would increase as infrastructure is modified to restore natural water flow patterns on the refuges. Some of these activities would result in longer periods of time when motorized equipment is used.

Overall, the long-term impact on regional air quality would be negligible.

Alternative D

The addition of several seasonal auto tour routes would expand vehicle access by 4 miles on the Monte Vista Refuge, 3.6 miles on the Alamosa Refuge, and 28 miles on the Baca Refuge. These seasonal roads would likely be dirt or gravel with limited access during winter months or other periods of inclement weather. Visitation to the Baca Refuge would be expected to grow slowly and would be dictated largely by increases in money for staff and road improvements as well as outreach efforts. In the long term, we would expect visitation to grow by 25–40 percent (4,000–6,000) for the Monte Vista and Alamosa Refuges and we would expect 15,000 or more visitors per year for the Baca Refuge. We expect the number of vehicles to be far less, and we would expect that many visitors would be participating in activities such as walking, biking, hunting, and fishing rather than driving around. Speed limits on refuge roads would remain low, which would reduce emissions. As described above, many of the visitors to the refuges are local or from within the State. Emissions levels would be negligible in the short term and minor to moderate in the long term, depending on the actual increases in visitor use, location, and timing of use.

Under this alternative, equipment use for other refuge operations would be similar to alternative A for the Monte Vista and Alamosa Refuges, although there would be increased use of equipment for improving roads for public use and the building of the visitor center at the Monte Vista Refuge. These would result in short-term increases in emissions. The Baca Refuge would have substantial increases in the use of motorized equipment to construct and finish roads, kiosks, picnic areas, displays, wildlife observation areas, parking lots, and overall improvements related to a considerable increase in public use of the refuge.

Overall, the long-term impact on regional air quality would be negligible.

Conclusion

As compared to alternative A, the implementation of alternative D would result in the greatest increase in all emissions because of more visitors and their vehicles. Alternative C would be similar to alternative A but would result in more equipment used for altering infrastructure. In the short term (the first 5years), the implementation of any of the alternatives would result in negligible increases in all emissions because it would take time to get more money to improve existing roads for visitor travel and increase staff levels. The opening of the Baca Refuge to the public would be a slow process. Regionally, over the long term (15 years or more), emissions, though increased, would still remain low regardless of the alternative chosen. Over the long term, the opening of the Baca Refuge to public use would be expected to result in localized, short-term, and temporary increases of dust, particularly if alternative D were implemented.

Implementation of any of the alternatives would result in negligible changes to air quality in the region.

Effects on Soils

In this section, we discuss the effects on soils of our habitat management and visitor services activities.

Restoration Activities and Infrastructure Management

This section describes the effects of our restoration activities on soils.

All Alternatives

Routine management activities that result in soil disturbance would occur on all refuges. This includes activities such as disking; tilling; cleaning ditches; and removing, adding, or modifying levees and water control structures. On all refuges, there would be habitat restoration projects that would require the use of heavy equipment. On the Monte Vista Refuge, the planting of crops under a cooperative farming program would continue under alternatives A and B and increase under alternative D. Under all alternatives, including alternative A, these activities would result in short-term minor disturbances of soil. These activities could result in localized, short-term erosion, soil loss, and even the release of soil particles (dust) into the air. Once a project has been completed and vegetation restored, soil protection and productivity would be preserved in the long term.

On the Monte Vista Refuge, over the long term, the soil chemistry would likely change in areas that are converted from wetland to upland. Negligible changes in soil chemistry would occur under alternatives A and D, with minor changes under alternative B and minor to moderate changes under alternative C.

Alternatives A (No-Action) and D

Under alternative A, there would be few changes to the current management of wetlands and upland areas. Although there would be localized restoration or infrastructure activities across the refuge complex, these would be small projects. Under alternative A, where money allows, we would restore sections of the riparian corridors on the Alamosa and Baca Refuges in part by fencing off riparian areas from ungulates and implementing actions to reduce erosion. We would expect there to be negligible changes to soil resources under alternatives A and D as we would be managing much as we have in the past.

Alternatives B and C

Under alternative B and to a much greater extent under alternative C, we would begin restoration of historical water flow patterns through some areas on the Monte Vista and Alamosa Refuges. We would hold water longer in some areas or move water to more closely mimic historical water patterns, including natural overbank flood events. This would be far more pronounced under alternative C, under which we would begin to restrict water application to natural water flowpaths and depressions associated with Spring Creek, Rock Creek, and Cat Creek on the Monte Vista Refuge. This could involve removing or modifying levees and water control structures to facilitate movement of water into deeper channels and other areas that traditionally held water. We could remove the ring dikes and ponds, levees, ditches, or even roads that are impounding water. Restoration activities could involve bringing in heavy equipment to remove levees, ditches, and ponds. Restoration might be as simple as removing boards on a water control structure or taking a culvert out and putting in a low water crossing. Evaluation of specific ditch and levee modifications would require detailed hydrological and topographical analyses and possible engineering (Heitmeyer 2013a,c). Activities could require permits or further environmental analysis under NEPA. These details would be filled in under a specific stepdown plan. Impacts to soil resources would be negligible to minor and generally short term under alternative B and would be minor to major and short term under alternative C.

Similarly, under alternative B, the restoration of former agricultural fields on the Monte Vista Refuge (100 acres) and Alamosa Refuge (50 acres) could result in localized, short-term, negligible erosion during restoration activities. Planting native grasses or shrub species would reduce potential erosion and provide positive benefits for grassland birds. Under alternative C, on the Monte Vista Refuge, we would begin restoration on a minimum of 1,000 acres of formerly converted wetlands and 450 acres of retired farmland and areas where grain is produced for sandhill cranes. Although the amount of soil disturbance would be considerably more than under alternative B, as described above, the disturbance would be short term and negligible in the long term. Because restoration would follow a phased approach, it would reduce the amount of soil disturbance at any given time.

On the Baca Refuge, under alternatives B–D, we would restore about 21 miles of riparian habitat on four creeks using a variety of tools such as fencing, active planting, and heavy equipment. Water control structures would be maintained, modified, and replaced under all alternatives. In the long term, our management actions would be largely beneficial for soil resources as soil erosion, sediment transport, and further channel incising would be reduced. Some restoration activities along the riparian corridors could require the need for heavy equipment, which would result in short-term disturbances to soils.

Mowing, Haying, and Livestock Grazing

Under all alternatives, we would use mowing, haying, and livestock grazing to mimic natural herbivory, which would improve most of the habitats on the refuge complex. With defined habitat objectives, these activities can stimulate new plant growth, reduce the amount of residual vegetation, and increase the vigor of plant communities.

Because livestock tend to use the same trails to access water or graze in riparian areas, there could be localized soil compaction, short-term losses of vegetation, soil erosion, and increased sedimentation. In general, we use livestock for several weeks in a specific area before they are moved, but in some locations, it could be longer. Livestock would be kept out of riparian areas unless there is a specific reason to use them to reduce invasive weeds. We only use grazing where it is needed. For example, a unit might be grazed once every few years and then rested. Once vegetation starts to get thick and matted, it would be grazed or burned again.

USFWS

Prescribed haying is one habitat management tool used on Baca Refuge. We also use other tools such as prescribed grazing and fire to meet specific management objectives.

Prescribed Fire

When used as a habitat restoration tool, prescribed fire would temporarily reduce vegetation in a treatment area. Generally, the use of prescribed fire would quickly stimulate new plant growth and increase the vigor of existing plant communities. There is the potential to cause short-term soil erosion as a result of water erosion from heavy rains or wind erosion; however, there are few steep slopes on the refuges. Many of the habitats on the refuges have sandy soils which have high infiltration rates.

Under all alternatives the impacts of prescribed fire on soils would be localized and negligible to minor.

Visitor Services Facilities

The effects of our visitor services facilities, including buildings, roads, and other structures, on soil are described.

Alternative A

Under alternative A, we would keep our existing facilities and few new facilities would be built, resulting in negligible impacts on soils.

Alternative B

Under alternative B, a new visitor center and refuge operation office with an area of less than 5 acres including parking would be built at the Monte Vista Refuge within the general footprint of the existing refuge buildings. Topsoil would be removed during construction of the new building and parking area. The auto tour route on the Alamosa Refuge would be expanded to the east, which would result in a widening of the existing Service two-track road (one lane) to a 1 ½ or even 2-lane gravel road along 3–4 miles. The development of these facilities would result in minor to moderate short-term soil disturbance and potential erosion along the footprint of the building site or road. This could be reduced through best management practices. New construction would mostly follow the footprint of the existing building or two-track roads, but in some locations, it may be necessary to reroute a road or trail to avoid impacts to wildlife or wetlands or to improve wildlife viewing. On both the Monte Vista and Alamosa Refuges, 3–5 viewing blinds or platforms would be built but their footprints would be small (with a total area of <l–2 acres for all including parking). The existing nature trail (interpretive trail) on the Monte Vista Refuge would be lengthened by about 1 mile and made accessible along the entire route (<1 acre soil disturbance). On the Alamosa Refuge, there would be about 2–3 miles of new nature trails provided along an existing two-track Service road, which would result in negligible new soil disturbance except as needed for signs or other interpretive exhibits. The opening of existing trails on both the Monte Vista and Alamosa Refuges for hikers and nature enthusiasts would result in negligible soil disturbance.

On the Baca Refuge, we would build about 10 miles of trails (3 miles of walking and 7 miles of nature trails) some of which would occur on an existing road or other existing disturbance. About 22–25 miles of existing two-track roads would be improved for the auto tour route and public access. Existing two-track roads could be widened to 1½ or two lanes with shoulders.

Across the refuge complex, in the short-term, road and visitor services improvements would result in minor to moderate negative impacts to soils. In the long-term, the impacts would be negligible to minor. Negative impacts to soils could be reduced by following best management practices, such as controlling erosion, minimizing grading, and installing necessary culverts.

Alternative C

Alternative C would be similar to alternative A in terms of impacts to soils as there would be few improvements made and therefore little soil disturbance. There would be some additional access for hunters on the Baca Refuge that could require improvements to existing roads. A tour route would not be built.

Alternative D

Alternative D would have the most added infrastructure, and therefore it would result in the most disturbance to soils from the construction of visitor service facilities. Similar to the impacts described under alternative B, the development of new facilities would require soil excavation, grading, and other surface disturbances, including the removal of topsoil for building the new visitor center at the Monte Vista Refuge. Temporary increases in soil erosion would occur during construction of new facilities, resulting in direct, short-term effects on soils. Although long-term losses in soil productivity would occur in some areas, overall the impact would be negligible across the refuge complex.

Long-term soil disturbances and erosion would be reduced by following best management practices during construction and properly maintaining roads. Besides the impacts identified under alternative B, 4 more miles of seasonal auto tour route on the Monte Vista Refuge would be available within the footprint of existing Service roads. Under this alternative, there would be nearly 3.5 miles of nature trails built on the Monte Vista Refuge as compared to 2 miles under alternative B and 0.25 mile under alternative A. On the Alamosa Refuge, the nature trail identified under alternative B south of the Bluff Overlook would also become a seasonal auto tour route. On the Alamosa Refuge, several locations would allow fishing access, which could lead to social trails (trails that develop through continual use) and soil disturbance near the river.

On the Baca Refuge, nearly 48 miles of roads could be available for public access. Most of these roads would be open seasonally and would not be wider than 1½ lanes. As under alternative B, road and trail improvements would generally follow existing two-track roads, which would limit soil disturbance, but in some areas, roads would need to be rerouted.

Overall, across the refuge complex, there would be moderate short-term impacts to soil resources that would diminish in the long-term to negligible to minor impacts from visitor services.

Management of Cultural Resources

Wherever possible, adverse impacts to significant cultural resources would be avoided, but in some instances, soils could be disturbed if excavation of cultural resources or removal of historic structures was deemed necessary. Negative impacts would be localized, short term, and negligible as a result of vegetation and soil disturbance. If necessary, active soil control measures would be used under all to protect important structures. Alternative C would result in the most number of structures being removed on the Baca Refuge.

Conclusion

Implementation of any of the alternatives would result in some negative impacts to soil resources. Generally, these would result in short-term, localized, and negligible or minor impacts, such as soil disturbance and transport, compaction, and erosion as a result of habitat management, infrastructure modification, prescribed fire, public use activities and facilities, archaeological surveys, or structure removal. Soil disturbance would be offset by the long-term benefits to habitat or species diversity and improvements to public access. Indirect long-term changes to soil chemistry would occur on parts of the Monte Vista and Alamosa Refuges that transition from being a wetland to upland as efforts are made to mimic natural water flow. Changes in soil chemistry could be viewed as negative or beneficial, depending on the outcome for wildlife diversity, reduction in invasive species, or more efficiency in water management. Although detailed plans would require further analysis, we would expect the greatest change to soils would occur under alternative C and to a lesser extent under alternative B. Alternatives A and D would result in the smallest changes in soil chemistry, as we would manage wetland areas to the extent that we have in the past; even under these alternatives, however, less water availability in the future would result in changes to soil chemistry.

There would be long-term losses in soil productivity from the development of public use facilities under alternatives B, C, and D as compared to the no-action alternative, but overall these would be negligible to minor because most facility development would occur within existing disturbed areas and could be reduced by following the best management practices. The greatest effects on soils would occur under alternative D, followed by B and then C.

Mitigation for Impacts to Soils

Losses in vegetation and subsequent soil disturbance could be reduced by ensuring that the best management practices were followed during construction activities, restoring flowpaths, excavation of cultural resources, and the development of visitor services structures or facilities. Mitigation could involve not disturbing soils during dry or windy periods, using erosion controls, properly maintaining roads and culverts, keeping livestock out of riparian areas, and using the minimal tools necessary to accomplish the objective.

Effects on Water Resources

Effects on water resources were evaluated based on existing information about water availability and quality in the refuge complex as well as any potential for refuge activities to negatively affect water resources on or off the refuge complex.

Water Quantity and Quality

Under all alternatives, we would keep our water rights and maximize ground and surface water for the primary purposes for which the refuges were established. Under every alternative, we would comply with new State water regulations for water augmentation. Given financial constraints and predictions for drought and climate change, it is unlikely that we could pump water to all the existing wetlands as has been done in the past. Under alternatives B–D, the development of a water quality monitoring program for identifying contaminants would help address water quality issues.

Inventorying all wetlands would help us to identify the most productive wetlands and use our water resources in these areas. Exploring the legal and practical feasibility of using Closed Basin Project mitigation water in different proportions and locations on the refuges would also help us to manage our resources effectively. Modifying existing infrastructure would enable us to direct water more efficiently by re-establishing natural flow patterns and using our limited water resources for key wetland areas. By installing ground water measurement devices to monitor ground water levels and by monitoring water quality, these actions would provide moderate benefits in managing water resources on the refuges.

Habitat Management

On the Baca Refuge, successful restoration of our riparian habitat under alternatives B, C, and D would result in a long-term improvement in the natural hydrology of the creeks that flow within the refuge. This would be accomplished by directly managing erosion and sediment and by stopping further channel incising.

On the Alamosa Refuge, none of our activities would significantly change the hydrology of the Rio Grande. We could make limited improvements in some off-channel areas where water management could provide for increased ground water, which in turn would help willow and cottonwood habitat. On the Alamosa Refuge, our restoration strategies under alternatives B and C are expected to mimic natural hydrologic conditions within the refuge, which would enhance the survival and health of willows, cottonwoods, and other riparian vegetation. We would expect to see the biggest beneficial impacts under alternative C and to a lesser extent under alternative B, because modifying or installing new water management infrastructure and managing grazing by all ungulates would improve the hydrology.

Under every alternative, we would continue to irrigate the wet meadows on the Baca Refuge, although the amount could vary depending on where we need water the most, the amount of water available from year to year, and the requirements of Closed Basin Project. We would also use flood irrigation on the Monte Vista and Alamosa Refuges.

Under alternative B and to a greater extent under alternative C, we would try to restore natural flow patterns, which would enable us to use our finite water resources more efficiently for wildlife. Some existing wetlands would receive less water and would transition to native grasslands.

Public Use Activities

Public use has the potential to degrade water quality, and increased use would mean more potential for trash or other wastes to be washed into streams.

Under alternative A, most of the Monte Vista and Alamosa Refuges would remain off limits to most visitors except during various hunting seasons. Under alternatives A and C, the number of visitor use days is unlikely to significantly increase either in the short term or long term. Impacts to existing water resources from trash, dog feces, or even human waste would be negligible and would be contained to existing parking areas, trails, or overlooks.

Under alternatives B, C, and D, access opportunities would increase, which could result in effects on water resources. The potential for negative impacts to water resources is greatest under alternative D, followed by B and then C. For the most part, most negative impacts would be limited to localized areas along trails, roads, or parking areas. Under alternative D, fishing access would be allowed in some locations along the Rio Grande; besides moderate increases in public use, this would result in more negative impacts to water resources from trash, bait, fishing lines, and social trails. Many of these impacts could be reduced through the use of viewing blinds or platforms, hardened trails, outreach and education, and increased law enforcement.

Overall impacts to water quality would be negligible under alternatives A and C; negligible to minor under alternative B; and minor to moderate under alternative D.

Effects on Visual Resources and Night Skies

Effects on visual resources are often qualitative, depending on the individual, location, and time of year. Visual impacts may include both distant and close views. In this section, we discuss the potential impacts of our habitat management practices, refuge operations, and visitor services.

All Alternatives

Under alternative A, there would be few noticeable changes to the visual resources or night skies of the refuge complex. For some visitors, invasive species would negatively affect the views from along nearby roads, auto tour routes, and viewing areas such as Bluff Overlook. The riparian corridors would continue to be heavily browsed or affected by invasive species. With existing staff and funding levels, it would be difficult to fully restore the riparian corridors in the Alamosa and Baca Refuges. Most stream corridors would remain heavily browsed with unsightly streambanks that are largely entrenched and denuded of vegetation.

Under alternatives B through D, our efforts to restore of 21 miles of riparian areas within four creek drainages on the Baca Refuge would have minor to moderate benefits on visual resources, both within the refuge complex and from nearby roadsides and viewing areas. Where hydrology allows, we would restore corridors with stands of willow and cottonwood to achieve a wider canopy along the corridor. Not only would successful restoration of the riparian corridors improve bird diversity and abundance resulting in more wildlife to view, but a lush and healthy riparian area would be pleasant to look at.

During prescribed burns, there would be short-term, localized negative effects on visual resources, largely from smoke. Blackened vegetation would be visible in localized areas immediately after a fire. Depending on the time of year and moisture levels, many areas would green up within several weeks, but some shrubland areas could take longer to recover. Under all alternatives, any negative effects on viewsheds from our use of fire would be negligible in the short term. In the long term, the prescribed fire program would increase plant and wildlife diversity and improve scenic values and wildlife viewing.

The visual impact from livestock grazing would be similar under all alternatives. There would be short-term negative effects on visual and scenic resources when viewed up close because of manure and trampling of vegetation. The structures used to help move cattle from on and off the Baca Refuge would remain, but these are generally not obtrusive and would have a negligible impact on aesthetics overall.

Under all alternatives, the overall scenic values of the refuges would be largely preserved. In localized areas, new facilities constructed under alternatives B and D could interrupt landscape vistas, but given the small footprints of these proposed facilities, these would have negligible to minor impacts on views or scenic qualities. Under all alternatives, the small clusters of Service buildings at the Monte Vista, Alamosa, and Baca Refuges would continue to exist. For the most part, any new facilities or improvements constructed under alternatives B and D would take place along existing roads or parking areas. Any new buildings such as the visitor center at Monte Vista would occur within the existing building footprint and would be at a similar height as existing structures. There would also be more vehicles visible on the refuge complex from some vantage points. There could be limited short-term negative effects from construction of new trails, viewing blinds, kiosks, and parking areas that would cease after construction. Most of the hundreds of miles of two-track roads would remain for refuge operations and monitoring of the Closed Basin Project on the Alamosa and Baca Refuges. Infrastructure related to wells and irrigation would remain.

The auto tour route is not expected to be open at night, which would preserve the dark night skies. Design features such as unobtrusive placement of exterior lighting could further limit visual impacts.

Overall, in the long-term, implementation of any of the alternatives would result in negligible impacts to the visual resources of the refuge complex.

Mitigation For Visual Resources

All new facilities, including buildings, roads, and trails, should be designed to limit their visual impact on the landscape. New facilities built on the Baca Refuge should reduce light pollution through the use of motion-activated lighting or should be shielded away from the Baca Grande subdivision, in keeping with the subdivision's policies for lighting. Any new use of alternative energy structures (windmills or solar panels) would be carefully sited to limit any visual impacts.

Effects on Soundscapes

Like visual resources, noise effects on the natural acoustic environment are often qualitative in nature. Refuge operations, including visitor services and refuge machinery, are considered as noise sources in this section.

All Alternatives

Overall, the implementation of any of the alternatives would have negligible impacts to natural sounds. Opening the Baca Refuge to public use under alternatives B and D would result in more traffic on refuge roads, but decibel levels would be expected to remain within the 15–45 dBA range, which is typical for rural areas. (Refer to table 10 and 11, chapter 4.) The auto tour route would be a considerable distance away from the Baca Grande subdivision, Great Sand Dunes National Park and Preserve, and nearby designated wilderness areas or wilderness study areas. Under all the action alternatives, there would be increased use of motorized equipment for refuge operations such as infrastructure modification or maintenance, building a visitor center under alternatives B and D, and bison management operations under alternative D. Any increased used of motorized equipment that would exceed 65–75 threshold for vibration velocity levels (VdB) would be short term (a few hours or weeks), except for the building of the visitor center on the Monte Vista Refuge, which would likely take several months to complete. No construction activity would take place at night.

During hunting season, occasional sounds of gunfire would be heard under alternatives B, C, and D on the Baca Refuge. Other than the dispersal hunts on former State lands, hunting would not occur on the Baca Refuge under alternative A. Gunfire would be infrequent and limited to daytime hours during open hunting seasons. The distance that it could be heard would vary, depending on terrain, weather, and other factors. Because of the short-term duration and infrequency of events per day, occasional gunfire would not be expected to negatively affect any residents in Crestone or the Baca Grande subdivision.

Cumulative Impacts on the Physical Environment

None of the proposed alternatives would result in cumulative effects on air quality; visual resources and night skies; soundscapes; geology; minerals; or soils when combined with the activities described under chapter 3, Foreseeable Activities.

The long-term benefits of the Service's efforts to reduce energy consumption and to protect vegetated habitat and wetlands would result in cumulative benefits when combined with programs and initiatives by the Service and the Department of the Interior to reduce the carbon emissions from and mitigate the effects of climate change on refuges. The overall cumulative benefit, however, would be negligible.

In all action alternatives, the Service will monitor water quality and manage water resources to improve the effectiveness of water use on the refuges. These beneficial effects of refuge management, when combined with external programs and efforts in the valley, would result in cumulative benefits to water resources.

5.5 Effects on the Biological Environment

This section describes the potential effects of the alternatives on biological resources. The main resource topics are riparian habitat; wetland habitat; playa habitat; upland habitat; threatened, endangered, and sensitive species; bird species; and other wildlife. The analysis considers both the effects of management intended to enhance biological resources and the effects of other refuge management actions such as visitor services on those biological resources.

Riparian Habitat

The effects on riparian habitat are discussed in this section.

Effects of Riparian Habitat Management

This section discusses the effects of our habitat objectives and strategies for each alternative.

Alternative A

This alternative would continue the current management direction, which includes managing refuge lands to provide habitat for riparian species and addressing habitat degradation issues associated with overbrowsing by elk on the Baca Refuge. These efforts would result in a negligible long-term benefit to riparian habitat on the refuges.

Alternatives B, C, and D

We would use a variety of management strategies to maintain and enhance at least 50 acres of riparian vegetation on the Alamosa Refuge and establish at least 50 more acres of habitat in off-channel areas. These established areas would ideally consist of tall, dense, and structurally diverse woody vegetation and would improve the quality of riparian habitat for a variety of wildlife species. These actions would also help stabilize river banks, improve sediment deposition and point bar formation, and encourage cottonwood seed germination. By planting willows and cottonwoods in suitable off-channel locations where we have the available water and infrastructure, we could control hydrologic inputs to promote the establishment and survival of new woody plants. These actions would provide a foundation for the maintenance and improvement of habitat over the long term, resulting in moderate long-term benefits to riparian habitat on the Alamosa Refuge.

Restoring woody riparian habitat could result in localized effects in other areas where water availability would be reduced. Disturbance caused by activities such as planting, fencing, prescribed fire, and mowing, which may be necessary to enhance riparian habitat, could also result in localized, short-term effects. These effects, however, would be negligible when compared to the overall scale of riparian habitat on the refuge and would be offset by the long-term benefits of the enhancements. The application of water to newly restored riparian habitat would likely reduce water availability in other areas, which could have adverse effects on short- or tall-emergent habitat in those areas. These effects are discussed below under Wetland Habitat.

On the Baca Refuge, vegetation enhancement, water manipulation, and elk management would be used to restore and preserve tall, dense, and structurally diverse riparian habitat. These efforts would result in a minor long-term benefit to riparian habitat on the Baca Refuge. We would continue to install ungulate-exclusion fencing as resources allowed. This would improve wildlife habitat; increase the abundance of invertebrates; provide more migration, foraging, and nesting habitat for songbirds; and improve overall habitat for small mammals, reptiles, and amphibians. These habitat enhancement efforts would also improve the overall stream function by encouraging cottonwoods and willows to stabilize stream banks while allowing lateral stream movement, sediment transport, and sediment deposition. Over time, these improvements to the overall structure of the stream and its associated riparian vegetation would be expected to enhance instream habitat, raise the water table, facilitate vegetation establishment, and promote the long-term quality and function of riparian habitat.

The use of management tools such as mowing, hydroaxing, and prescribed fire in riparian areas would result in substantial effects on some areas, because existing vegetation would be modified or destroyed. These short-term, moderate effects would be limited to localized treatment areas and would be offset by the long-term benefits described above. Overall, these alternatives would have moderate long-term benefits on riparian habitat on the Baca Refuge.

Effects of Visitor Use Management on Riparian Habitat

This section describes the effect on riparian habitat of visitors and the facilities to support them.

Alternative A

Under this alternative, we would keep our current visitor use programs and facilities. No new trails, roads, or facilities would be constructed in or near riparian habitat, and human disturbance would remain similar to current levels. Overall, visitor use management under alternative A would result in negligible long-term effects.

Alternative B

Under this alternative, we would facilitate visitor access to the Alamosa Refuge by expanding the current auto tour route east to connect with the Bluff road (county road S116); lengthening the Bluff nature trail; creating a trail link to the refuge from Alamosa (nature trail); establishing several new shelters and interpretive sites; and expanding access to existing trails. During waterfowl season, public access would not be restricted to trails and roads. On the Monte Vista Refuge, new interpretive sites would be established, seasonal access to existing trails would be expanded, and a new nature trail would be added. On the Baca Refuge, auto tour routes and interpretive facilities would be established and new trails would be added near Cottonwood Creek and the new headquarters and visitor center. Total visitation to the refuges is expected to increase by 15 to 25 percent.

New visitor access and facilities could negatively affect nearby riparian habitat. Besides the vegetation removal and soil compaction associated with the construction activity, new trails within or through riparian habitat can also fragment habitat, create edges, and disturb wildlife. Habitat fragmentation results from a new trail, road, or facility dissecting a large patch of riparian vegetation. The creation of smaller patches reduces the availability of interior habitat and increases edge effects. Many species, particularly songbirds, rely on interior habitat for nesting and are more vulnerable to increased predation near habitat edges. The presence of visitors on trails can have negative effects on nearby wildlife, including increasing stress and energy expenditure as well as reducing foraging, food delivery to offspring, and reproductive activity. While wildlife sensitivities to disturbance vary by location, terrain, species, and individual animals, these effects are generally known to occur near (50 to 100 meters) trails and facility areas, and can result in abandonment of habitat areas by affected animals (Miller and Hobbs 2000, Miller et al. 1998).

These types of effects could occur with the expansion of the Bluff nature trail on the Alamosa Refuge and near the multiple creek crossings associated with trails and roads on the Baca Refuge. Because there is no riparian habitat on the Monte Vista Refuge, there will be no disturbance to riparian habitat from visitors. The effects of trail and facility development on riparian habitat and wildlife can be reduced by carefully routing trails to minimize crossings and fragmentation, and by incorporating buffers around high quality habitat areas. Also, increased education efforts will encourage visitors to remain on established trails.

Overall, the increased visitor use and facilities would have minor, long-term effects on riparian habitat. Any negative effects would be greater in the immediate vicinity of the visitor facilities, but those areas would be a small percent of the riparian habitat available on the refuges and any effects could be reduced by some of the siting and management measures mentioned above.

Alternative C

Under this alternative, we would keep our existing programs and facilities on the Alamosa and Monte Vista Refuges. Visitor use facilities and access would be similar to the no-action alternative, except for the introduction of limited access to the Baca Refuge. The Baca Refuge would also be opened to limited guided access and hunting. Overall, visitor use objectives under alternative C are expected to have a negligible to minor long-term effect on riparian habitat.

Alternative D

Under this alternative, we would emphasize visitor use by expanding trails, auto tour routes, interpretive sites, and programs on all three refuges. More hunting opportunities would be provided as well. Total visitation to the refuges is expected to increase by 25 to 40 percent.

Under this alternative, effects on riparian habitat would be similar to those described for alternative B, but at a greater magnitude. New visitor access and facilities could negatively affect riparian habitat in areas where they intersect or are near riparian habitat, resulting in localized habitat degradation and fragmentation of larger habitat units. Likewise, the increased presence of visitors on the refuges (both on and off developed trails and facilities) would increase the level of disturbance. As mentioned earlier, these effects are generally known to occur near (50 to 100 meters) trails and facilities, and can result in abandonment of habitat areas by affected animals.

Overall, the increased visitor use and facilities would have minor to moderate long-term effects on riparian habitat. While the adverse effects may be greater within the immediate vicinity of the visitor facilities, those areas would be a small portion of the riparian habitat available on the refuges, and can be further reduced by some of the siting and management measures mentioned above.

Wetland Habitat

The effects of our management actions on wetland habitat are discussed in this section.

Effects of Wetland Habitat Management

This section describes the potential effects of our habitat management actions on short- and tall-emergent wetland communities.

Alternative A

Under this alternative, we would continue to sustain short- and tall-emergent wetland communities on the refuges and manage water levels to provide habitat for waterfowl, sandhill cranes, shorebirds, and other bird species. Wet meadow habitat on the Baca Refuge would continue to be managed to control noxious weeds and provide valuable habitat for native wildlife species, especially migratory birds. The continuation of current wetland management practices would maintain and potentially improve the integrity of wetland communities on the refuges, but these practices would not substantially expand the size, function, or diversity of these habitat areas. Overall, these ongoing management efforts on the refuges would have minor, long-term benefits to wetland communities.

USFWS

Water management would have varying effects on some wetland areas in the future on Monte Vista and Alamosa Refuges.

Alternatives B and D

Under alternative B, we would provide water to both created and natural wetlands on the Monte Vista and Alamosa Refuges during the spring migration, nesting, brood rearing, and fall migration periods. Although water management would attempt to follow natural hydrologic cycles, we would have the flexibility to apply water in times or locations that are not natural, such as during late summer and fall to support fall migration or waterfowl hunting. Some created wetlands would no longer be irrigated, and this water would instead be provided to natural flowpaths and riparian areas. A variety of management tools including prescribed fire, grazing, and haying would be used to manipulate vegetation to encourage more vigorous growth, to provide a specific vegetative structure for species such as shorebirds, or for invasive weed control.

These strategies are expected to help preserve the long-term function and productivity of wetland habitat and to promote wetland communities that are ecologically resilient to climatic and hydrologic changes. The more dynamic use of water and disturbance events such as prescribed fire, grazing, and haying is expected to create a diverse set of habitat conditions that will help wetland-dependent wildlife, especially waterfowl, wading birds, shorebirds, and songbirds.

Managing water and wetlands for particular species would result in a variety of benefits. Water inputs during spring migration would promote earlier vegetative growth; greater plant height, density, diversity, and vigor; improved aquatic invertebrate production; improved habitat for amphibians; enhanced breeding habitat for waterfowl and other wetland birds; and improved foraging, breeding, and roosting habitat for other wetland birds. Water application and vegetation manipulation during the nesting season would improve nesting and foraging conditions for waterfowl, wading birds, shorebirds, and songbirds. Areas that are not flooded would provide nesting and foraging habitat for songbirds such as Savannah sparrow, vesper sparrow, and western meadowlark. In the late summer brood-rearing period, watering some areas would maintain aquatic invertebrates as an important food resource, while gradual drying of other areas would promote moist soil plants that are a food source in the fall. In the fall, the remaining wetlands would continue to provide water, food, and cover for migrating wetland birds, especially waterfowl and sandhill cranes. Keeping other areas dry would limit the proliferation of cattails into wetland areas.

Removing levees and allowing created wetland areas to revert back to native upland vegetation would result in fewer acres of wetland habitat and would reduce the wetland resources available for wildlife. The physical removal of levees would greatly affect the immediate project area by removing, trampling, or burying vegetation. Dewatering some created wetland areas would result in the loss of wetland habitat, resulting in a minor impact to affected areas. However, the overall effect of these actions would be minimal because the quality of habitat in the affected areas is generally poor, while the quality of habitat in the natural flowpaths and associated riparian communities would increase and compensate for the lost wetland habitat. These areas, over time, would revert back to upland habitat.

On the Baca Refuge, one of the creek systems would not be used to irrigate wet meadow habitat because the water would be kept instream and provided to playa habitat. While this would result in short-term effects on these wet meadow areas, the re-establishment of a natural hydrologic cycle could increase the vegetative diversity and improve overall wetland health and function in these wet meadows, which would result in a long-term benefit. In addition, the shallowly inundated portions of wet meadows would have a wider distribution in the upper portions of the meadows than the lower portions. This would have a moderate to major effect on the vegetation composition in the downstream sections of wet meadow that would no longer be flood irrigated. These downstream portions of wet meadow would convert from short-emergent to grassland.

Vegetation manipulation such as prescribed fire, grazing, or haying would have minor short-term effects on some wetland areas and the wildlife in those areas. However, after a full growing season, those areas are expected to recover and improve in habitat quality.

Overall, the wetland management strategies proposed under alternatives B and D would have moderate long-term benefits to wetland habitat.

Alternative C

Wetland management objectives would be similar to those under alternatives B and D, except that we would provide water only to natural wetland areas and historic flowpaths and would do so during times and at depths that mimic the natural hydrology. All levees would be removed and artificial wetlands would be allowed to revert back to natural vegetation. The use of management tools such as prescribed fire, grazing, haying, and herbicide application would be used to improve vegetative health and habitat quality, but unlike alternatives B and D, these tools would be used to mimic historic disturbance regimes.

Changes to the application of water in terms of timing, depths, duration, and wet and dry cycles to mimic natural hydrologic patterns may change some wetland types that became established during earlier management strategies. For example, a short-emergent, season-long wetland could shift toward a short-duration ephemeral wetland that is dominated by saltgrass. These changes, however, would be expected to improve the health and sustainability of natural wetland areas and the wildlife habitat they provide.

Removing levees and allowing created wetland areas to revert back to native upland vegetation would result in substantially fewer acres of wetland habitat and would reduce the overall level of wetland resources available for wildlife. This would result in a minor, long-term effect because of the loss of certain habitat types. However, these effects may be offset by the creation of more habitat for upland wildlife species, the reduction in invasive weed infestations, and the greater availability of water to support and manage natural wetland areas.

On the Baca Refuge, changing to a more natural hydrologic condition that would keep more water in the creek channels would reduce the water availability for wet meadow habitat and reduce the overall extent of that habitat type.

Similar to alternatives B and D, the physical removal of levees associated with created wetlands will greatly affect the immediate area by removing, trampling, or burying vegetation. Likewise, the use of management tools such as prescribed fire and grazing would result in changes to the affected habitat areas. These effects would be sporadic, would be limited to the localized extent of the project area, and would dissipate over time, resulting in minor, short-term effects on wetland habitat.

Effects of Visitor Use Management

The effect of our visitor services activities on wetland habitat is discussed in this section.

Alternative A

Under alternative A, we would keep our current programs and facilities for visitors, and no new trails, roads, or facilities would be constructed in or near wetlands. Human disturbance would remain similar to current levels over time. Overall, visitor use management under alternative A would have a negligible effect on wetland habitat.

Alternative B

Under this alternative, visitor access and facilities would be expanded on all three refuges. New auto tour routes would be established on the Alamosa and Baca Refuges and new interpretive trails and facilities would be developed on all three refuges. During the waterfowl and small game hunting seasons, visitor access would not be restricted to trails and roads. Total visitation to the refuges is expected to increase by 15 to 25 percent.

As is the case with other habitat types, the construction of new facilities could degrade the habitat where the new facility is sited, while the increased presence of visitors can have negative effects on the function of the habitat and associated wildlife. In general, the increased disturbance to and flushing of wetland-dependent wildlife, especially birds, could result in reduced foraging, food delivery to young, and reproductive activity, and could ultimately result in the abandonment of affected habitat areas. Depending on the species, timing, and location, these effects from human disturbance could occur from 50 to 100 meters from a trail or facility. Wetland areas that historically provided high-quality brood habitat for waterfowl would be less suitable if there was a trail nearby. For some species, the use of auto tour routes would have similar effects.

Waterfowl hunting could also affect more than the specific animals that are taken. Because hunters typically travel off trail and into habitat areas, the wildlife in that area (both target and non-target species) are likely to be less habituated to the presence of humans, thus increasing their stress, flight response, and overall energy expenditure. However, these effects from hunting are tempered by the relatively small percent of hunters relative to the number of all visitors to the refuges.

Overall, visitor use objectives under alternative B would have minor to moderate long-term effects on wetland habitats, depending on the timing, location, and magnitude of visitor use and facilities. These effects could be reduced by locating facilities away from the most sensitive wetland habitat areas. Providing education and interpretation to the public about wetlands would contribute to long-term wetland conservation.

Alternative C

The level of visitor use facilities and access under this alternative would be similar to that under the no-action alternative, except for the introduction of limited access to the Baca Refuge. Overall, visitor use objectives under alternative C are expected to have a negligible effect on wetland habitat.

Alternative D

With a greater emphasis on visitor use under this alternative, we would expand trails, auto tour routes, interpretive sites, hunting opportunities, and programs on all three refuges. Total visitation to the refuges is expected to increase by 25 to 40 percent.

The effects of these activities on wetland habitat are similar to those described above for alternative B, but to a greater degree. The construction of new facilities would directly eliminate or degrade habitat in the immediate location, while the increased presence of visitors could have negative effects on the function of the habitat and the wildlife that depend on it. Wetland areas that provide high quality brood habitat for waterfowl would be less suitable if they are next to a trail. Disturbances from hunting may be greater because hunters typically travel off defined trails and roads, but the effects would be minimal because of the relatively low number and frequency of hunting disturbances.

Overall, the changes to visitor use under alternative D would have minor to moderate long-term effects on wetland habitats, depending on the timing, location, and magnitude of visitor use and facilities. These effects could be reduced by locating facilities away from the most sensitive wetland habitat areas, while still providing the educational and interpretive benefits that contribute to long-term wetland conservation.

Playa Habitat

The effects of our habitat and visitor use management activities on playa habitat are described. In the refuge complex, playa habitat is found only on the Baca Refuge.

Effects of Playa Habitat Management

The management of our water resources is discussed.

Alternative A

Under this alternative, little or no water would be applied to playa habitat areas. Playa-dependent species such as the snowy plover may find suitable habitat in wet years, but there would not be reliable habitat available because of the unpredictable nature of snowpack runoff and the greater water needs of the wet meadow communities. These conditions could also create a biological sink that would result in negative effects for birds that nested on playas that did not have a sustainable water supply. The potential for these negative effects is uncertain. Overall, this alternative would have negligible effects on playa habitat on the Baca Refuge.

Alternatives B and D

Under alternative B, we would provide water to playa wetlands when possible during the spring migration and summer nesting periods for waterbirds and shorebirds.

The proposed management strategies for playa habitat would provide nesting and foraging resources for shorebirds and some waterfowl species, and would restore playa habitat, including vegetation and soil chemistry. Over time, these actions may provide nesting habitat for snowy plover. However, because of the unpredictable nature of mountain snowpack and runoff (on which the water for playas would depend), it may be difficult to provide water during spring migration, and it is possible that the playas could dry up too early in the summer and have a negative effect on birds that nested on these sites. However, the risk of creating a biological sink for certain wildlife species is believed to be offset by the benefits of at least partially restoring and preserving these habitats over time.

Overall, the playa habitat management under alternative B would have minor to moderate long-term benefits to this habitat, depending on the availability of water to carry out those efforts.

Alternative C

Under alternative C, most of the available water would be allowed to reach the playa habitat areas, which would in turn provide habitat for waterbirds and shorebirds during the spring migration and summer nesting periods.

The effects under this alternative would be similar to those under alternative B for restoring and preserving the overall function of playa habitat and providing nesting habitat for snowy plover and other birds such as Savannah sparrow, western meadowlark, and vesper sparrow. However, the effects would be more extensive and more reliable over the long term. These actions would result in moderate to major long-term benefits to playa habitat, depending on the availability of water.

Effects of Visitor Use Management on Playa Habitat

The effects of our visitor use management on playa habitat are described in this section.

Alternative A

Under this alternative, there would be little visitor use on the Baca Refuge; subsequently, effects on playa habitat would be negligible.

Alternatives B, C, and D

Under these alternatives, some visitor use facilities are proposed near the playa habitat on the Baca Refuge. Limited access for elk hunting may also occur in these areas, but it is not expected to be frequent or substantial. Overall, visitor use under alternatives B, C, and D would have a negligible effect on playa habitat.

Upland Habitat

This section describes the effects of visitor use on upland habitat.

Effects of Upland Habitat Management on Biological Resources

The effects of our habitat management activities on upland habitats are discussed in this section.

Alternative A

We would continue to preserve native shrub and short grass upland communities on the refuges, which would involve inventorying and managing for noxious weeds or other signs of degradation. This alternative would have negligible long-term benefits to upland habitats on the refuges.

Alternative B

Under alternative B, we would incorporate disturbance regimes such as prescribed fire, grazing, mowing, and hydrological changes to create or preserve vegetation health and diversity in upland habitats. On the Alamosa and Monte Vista Refuges, some historic upland habitats that were formerly converted to wetlands or agricultural fields would be restored.

The implementation of these management measures, particularly the periodic disturbance regimes, would preserve and enhance the herbaceous communities and would create diverse shrub communities in terms of age classes and structural condition over the long term. These improved habitats would help wildlife by promoting invertebrate diversity and seed production and by providing foraging, nesting, and migration habitats. Wildlife species that would benefit include songbirds such as sage thrasher, Brewer's sparrow, and loggerhead shrike, as well as a broad range of small and large mammals. On the Baca Refuge's shrub-grass habitat, herbaceous vegetation would increase after a disturbance event such as fire (mosaic pattern) and would provide more nesting and foraging habitat for grassland birds.

By restoring old farm fields and created wetlands back to native upland habitat, upland birds would have more habitat for foraging, nesting, and migration. Over time, there would be reduced weed infestations in these areas as native upland communities became established. Because these areas would no longer be irrigated, more water would be available to restore wetlands and riparian habitat in other places.

Disturbance measures such as prescribed fire, grazing, and mowing would result in the short-term loss of nesting and foraging habitat in the affected areas. However, these measures may improve habitat for species such as horned lark that prefer sparse vegetation, and would result in long-term benefits to many species as more healthy and diverse upland habitats are established.


USFWS

Loggerhead shrikes and other breeding songbirds benefit from natural disturbance regimes.

Overall, the upland habitat management measures on the refuges would result in minor long-term benefits to upland habitat.

Alternative C

Similar to alternative B, we would incorporate disturbance events such as prescribed fire, grazing, mowing, and hydrological changes to create or preserve vegetative health and diversity in upland habitats. On the Alamosa and Monte Vista Refuges, historic upland habitats that were formerly converted to wetlands or agricultural fields would be restored. Compared to alternative B, more attention would be given to the timing and intensity of disturbance tools to mimic natural regimes. The effects of these actions on the refuges would be similar to alternative B, resulting in minor long-term benefits to upland habitat.

Alternative D

The impacts would be similar to or the same as alternative A.

Effects of Visitor Use Management on Upland Habitat

This section discusses the effects of visitor services on upland habitat.

Alternative A

We would keep our current visitor use programs and facilities on the refuges, and no new trails, roads, or facilities would be constructed within or near wetlands. Overall, our visitor use management under alternative A would have a negligible long-term effect on upland habitat.

Alternative B

Under this alternative, we would expand visitor access to the refuges including access for biking and walking. Limited horseback use could be available on the Baca Refuge. On the Alamosa Refuge, the auto tour route would be extended out to county road S116, and several more trails would be established, including another 3.6 miles of nature trails. On the Monte Vista Refuge, seasonal access to existing trails would be expanded, and a new nature trail would be added. On the Baca Refuge, auto tour routes and interpretive facilities would be created and new trails would be added near Cottonwood Creek and the headquarters and visitor center. Most of the new trails and roads would be located in upland habitat. Small game and waterfowl hunting would continue to occur on Alamosa and Monte Vista Refuges in addition to allowing for limited big game hunting. Small game and elk hunting would occur on the Baca Refuge. Total visitation across the refuges would be expected to increase by 15 to 25 percent. Not every road or trail would see the same increased levels of use.

As described for other habitat types, the construction of new facilities would result in direct effects on upland habitat in the immediate area, while the increased presence of visitors could have negative effects on the function of the habitat and associated wildlife. Fragmentation of habitat from the construction of new trails, roads, or facilities could reduce the quality of habitat in affected areas or interrupt movement corridors for some species.

Overall, the increased visitor use and facilities would have minor, long-term negative effects on upland habitat. While the adverse effects would be greater (moderate) within the immediate vicinity of the visitor facilities, these areas would be a small percentage of the upland habitat available on the refuges.

Alternative C

The level of visitor use facilities and access under this alternative would be similar to the no-action alternative except for the introduction of limited access to the Baca Refuge. While the individual effects of visitor use would be similar to those described for alternative B, the overall long-term effects on upland habitat would be negligible.

Alternative D

With a greater emphasis on visitor use under this alternative, we would expand trails, auto tour routes, interpretive sites, hunting opportunities, and programs on all three refuges. Visitation across the refuges would be expected to increase by 25 to 40 percent, although this could vary by refuge and trail.

The effects on upland habitat would be similar to those described for alternative B, but to a greater degree. The construction of new facilities would result in direct effects on upland habitat in the immediate vicinity, while the increased presence of visitors could have negative effects on the function of the habitat and associated wildlife.

Overall, increased visitor use and facilities would have minor to moderate long-term negative effects on upland habitat. While the adverse effects would be greater in the immediate area of the visitor facilities, these areas would be a small percentage of the upland habitat available on the refuges.

Threatened and Endangered Species

The effects of our management on threatened and endangered species are described in this section.

Southwestern Willow Flycatcher

The southwestern willow flycatcher is the only federally endangered species found on the refuge complex at this time. Currently, it is only found on the Alamosa Refuge. The effects of our habitat management and visitor services policies on the southwestern willow flycatcher are described below.

Habitat Management

Under all of the action alternatives, we would establish, preserve, and enhance willow-dominated riparian habitat on the Alamosa Refuge, with a goal of enhancing or preserving at least 100 acres of habitat (refer to riparian habitat objectives). This would expand nesting habitat for the southwestern willow flycatcher, and provide the potential for the establishment of several more flycatcher breeding territories on the refuge. If successful, these habitat enhancements would result in minor, long-term benefits to southwestern willow flycatcher on the Alamosa Refuge.

Effects of Visitor Use on Southwestern Willow Flycatcher

Alternative A

Under alternative A, visitor use would continue along the Rio Grande nature trail year round. Southwestern willow flycatchers are observed along this trail, often close to the parking area, current visitor center, and auto tour route. Not all portions of the Rio Grande trail are adjacent to riparian areas, but several portions are. The trail has some moderate levels of use as it is one of the few areas on Alamosa Refuge that is currently available for walking and wildlife observation (the existing Bluff nature trail is also open year round, but the area receives less use and the trail does not drop down to the riparian corridor). Under alternative A, visitor use of the Rio Grande nature trail would not be likely to increase. Without further monitoring, it is not clear whether current use levels are negatively affecting the flycatcher, but under alternative A, any increased impacts would be negligible.

Alternative B

As with alternative A, year-round visitor use would continue to be allowed along the Rio Grande nature trail. Visitors would be required to stay on the trail. With increased emphasis on other additional opportunities for wildlife observation and education on Alamosa Refuge, more use could occur along the trail, but with the visitor center and headquarters operation eventually being moved to Monte Vista Refuge together with other opportunities for public access, numbers would not be expected to increase substantially.

Under alternative B, portions of existing two-track roads and trails that are currently open only to hunters during the hunt season would be opened from July 15 to about February 28. The Bluff nature trail would be extended south and then north along an existing two-track road adjacent to the Rio Grande corridor to parking area 4. Following an existing two-track road, the trail would then continue north to parking area 5 for several miles. This area contains several small patches of willow riparian habitat that were historically documented to support flycatcher territories (most recently 2003) but are currently in very poor condition, primarily due to hydrologic changes. The opening of these trails would overlap with flycatcher breeding season by about a month and half (July 15 to September 1). Due to the considerable distance to get to the area, use along the southern trail would likely be light. If efforts to improve the hydrology in several areas and elsewhere along the river were successful, the quality of the riparian habitat could be improved. This would benefit the southwestern willow flycatcher, but would increase the potential for negative impacts associated with public use along the Bluff trail loop. Negative impacts could be reduced by rerouting portions of the trail, imposing an additional seasonal closure, signage, and increased education. Under alternative B, overall, impacts to southwestern willow flycatcher as a result of increased public use and access would be negligible to minor.

Alternative C

Visitor use would be similar to alternative B along the Rio Grande nature trail and in the portions of the existing hunt area that would be open for biking and walking after July 15th. The extent of the Bluff nature trail would be the same as under alternative A. Similar to alternative B, trail access would be permitted along the Rio Grande. Overall impacts to southwestern willow flycatcher from July 15 to around September 1 as a result of increased public use and access would be negligible to minor. Some portions of the trails could require rerouting or an additional seasonal closure to limit potential impacts.

Alternative D

Instead of extending the Bluff nature trail to the south and north to parking area 4, as described under alternative B, it would become a seasonal auto tour route. Fishing access would be allowed at two areas along the Rio Grande. With increased emphasis and opportunities for access under alternative D, potentially negative impacts on southwestern willow flycatcher could increase. Careful siting of the fishing access points would be necessary. Similar to alternative B and C, some portions of the roads or trails could require rerouting or additional seasonal closures put into place to limit any potential impacts to the birds should efforts to restore riparian areas result in additional flycatcher territories in the area. With the addition of fishing access, under alternative D, impacts could potentially increase to moderate levels.

Mitigation

Potential impacts to southwestern willow flycatcher could be limited by requiring visitors to stay on trails, increasing visitor education and law enforcement, rerouting the trail and road away from restored riparian areas, using additional seasonal closures as necessary, and monitoring for impacts.

Past management practices have been partly focused on supporting sandhill crane migration on Monte Vista Refuge. The alternatives consider different options for crop production in the future.

Sandhill Crane

Since current and past management practices have been partly focused on supporting sandhill crane migration, these effects are described separately from other birds. Sandhill cranes are also a focal bird species (refer to focal bird species in chapter 3).

Alternative A

Under alternative A, we would continue to grow small grains on the Monte Vista Refuge to support crane populations during migration. These ongoing actions would have minor long-term benefits to sandhill cranes.

Alternative B

Under alternative B, on the Monte Vista Refuge we would continue to provide water to traditional roosting areas in early spring (February to April) and fall, and grow small grains that provide a high energy food source. These actions would help sandhill cranes by continuing to provide them with necessary roost habitat and a food source for migration. Evidence suggests that if migrating cranes leave the San Luis Valley in good body condition, they are more likely to have a successful breeding season. These efforts would result in long-term, minor benefits to sandhill cranes on the Monte Vista Refuge.

Alternative C

Under alternative C, all Monte Vista Refuge farm fields would be allowed to revert back to native vegetation, which would reduce the availability of food for sandhill cranes. Minimal water would be available in the spring for roosting habitat. While the loss of refuge grain fields would be tempered by the availability of waste grain on nearby private fields, the loss of roosting habitat on the refuge could diminish the overall body condition of the cranes during their migration (personal communication, Dave Olson, FWS Division of Migratory Birds, April 24, 2014). With a reduction in the number of roost areas that would be flood (two out of three), the same number of cranes would have to fit into a smaller area, which could raise the potential risk for disease outbreaks. Overall, this could contribute to moderate to major long-term negative effects on the number of cranes that migrate through the San Luis Valley.

Alternative D

Under this alternative, we would expand small grain production to support sandhill cranes on the Monte Vista Refuge. This would result in a moderate long-term benefit to migrating sandhill cranes.

Focal Bird Species

This section describes effects on focal birds. (Refer to tables 3, 4, and 5 in chapter 3.)

Effects of Habitat Management on Focal Bird Species

Besides the potential effects described for the various habitats, this section describes specific effects of our habitat management on focal bird species.

Alternative A

The ongoing preservation of riparian, wetland, and upland habitats on the refuges would continue to provide essential breeding, foraging, and migration habitat for focal and other bird species. In general, the existing areas, conditions, and functions of the various habitat types would be preserved or improved. These habitat management efforts would result in negligible long-term benefits to bird species on the refuges.

Alternative B

As described for riparian and wetland habitats, we would manage the refuges to create habitat for focal and other bird species. Water application would be used to support wetland habitats during specific times of the year and for specific purposes, while management tools such as prescribed fire, grazing, haying, and herbicide application would be used to improve wetland and riparian habitats to help nesting and foraging birds.

Water management in wetland areas would preserve healthy vegetation and wetland function, providing habitat for a wide array of waterbird species, including ducks, shorebirds, wading birds, and songbirds. Some created wetlands would continue to be flooded, favoring wetland-dependent bird species in those areas. The artificial wetlands that are no longer flooded would revert back to uplands and would no longer be available for wetland bird species. Over time, however, these habitats would support upland birds. Also, species that prefer tall, dense cover for nesting or hiding (such as ducks or some marsh birds) could experience short-term effects from grazing, haying, or prescribed fire because of the removal of dense cover or because of disturbance from grazing. However, the long-term benefits of habitat enhancement are expected to offset the short-term, localized effects of management activities. Overall, habitat management efforts on the refuges are expected to have minor long-term benefits for focal birds and associated bird species.

Alternative C

Similar to alternative B, refuge habitats would be managed to support focal and other bird species by using strategic water application and management tools such as prescribed fire, grazing, haying, and herbicide application. These tools would be used to provide the vegetative structure for nesting, foraging, and other needs. Unlike alternative B, these tools would be used to mimic historic disturbance regimes. Because water would not be provided to created wetlands and farm fields, these areas would revert to upland habitats.

The shifts in habitat types that are expected to occur under this alternative will help some bird species and negatively affect others. In some areas, wetland-dependent birds would be adversely affected by an overall loss of nesting and foraging habitat, while upland bird species may benefit over the long term as more habitat becomes available. This would be particularly true on the Monte Vista Refuge. While the populations and distributions of different species would change, the emphasis on habitat health would help most bird species.

Changes in wetland hydrology could eliminate suitable nesting habitat for white-faced ibis, snowy egret, and black-crowned night-heron on the Monte Vista Refuge's Bowen and Parker Ponds. While this area is managed as a deeper, semi-marsh habitat, the natural condition would be a shallower, more seasonal wetland.

Overall, this alternative would result in minor long-term negative effects on wetland-dependent bird species on the refuges.

Alternative D

Same as under alternative B.

Effects of Visitor Use Management on Focal Bird Species

This section describes the effects of our visitor services activities on focal bird species.

Alternative A

Under alternative A, we would keep our current visitor programs and facilities on the refuges, and no new trails, roads, or facilities would be constructed. Visitor use in developed and undeveloped areas would increase the stress levels of individual birds, reduce body condition because of unnecessary energy expenditures, and result in decreased primary song, which could affect mate attraction and territory defense. Over time, these disturbances could result in a simplification of the bird community as affected habitat areas are used more by generalists and less by habitat specialists. The presence of dogs could also exacerbate the effects of visitor use on birds. However, these effects would be localized to the immediate vicinity of visitor use facilities or hunting areas, would be small in proportion to the available habitat on the refuges, and would remain similar to existing levels of disturbance. Overall, visitor use management on the refuges under alternative A would have a negligible adverse effect on bird species.

Alternative B

The effects of visitor use management on bird species are similar to those described in earlier habitat sections. Overall, visitor access and facilities under this alternative would be expanded on all three refuges. New auto tour routes would be established on the Alamosa and Baca Refuges and new interpretive trails and facilities would be developed on all three refuges. During waterfowl or big game hunting seasons, visitor access would not be restricted to trails and roads. The Baca Refuge would be opened for public access including big game and small game hunting. Visitation across the refuges is generally expected to increase by 15 to 25 percent, but would vary by trail, event, or refuge.

Across all habitat types, habitat fragmentation from the construction of new facilities could result in negative effects associated with habitat edges such as increased predation and cowbird parasitism, and localized loss of interior patch habitat where birds could establish territories. Human disturbance could increase the stress levels of individual birds, reduce body condition because of unnecessary energy expenditures, and result in decreased primary song, which could affect mate attraction and territory defense. Over time, these disturbance effects could result in a simplification of the bird community as affected habitat areas are used more by generalists and less by habitat specialists. Increasing visitor numbers would magnify the effects for many species, as would the proposed lengthening of the time of year when access is available and the introduction of other activities such as foot or bike travel to existing auto tour routes. The presence of dogs would exacerbate the effects on birds.

While the intent of a viewing blind is to allow visitors to observe wildlife with minimal effect on the animals, the establishment of a viewing blind near Parker Pond on the Monte Vista Refuge would still have the potential to affect white-faced ibis, snowy egret, and black-crowned night-heron breeding and foraging, as well as other wetland birds such as waterfowl and shorebirds. There are no visitor use facilities in that area.

Overall, the visitor use objectives under alternative B would have minor to moderate long-term negative effects on some bird species in some habitat areas, depending on the timing, location, and magnitude of visitor use and facilities. These effects could be reduced by locating facilities away from the most sensitive bird habitats, rerouting trails, increasing law enforcement and visitor education, and using additional seasonal closures when necessary. Waterfowl, small game hunting, and big game hunting occur outside of the nesting season and would have a negligible effect on birds.

Alternative C

The level of visitor use facilities and access under this alternative would be similar to the no-action alternative, except for the introduction of limited access to the Baca Refuge. The individual effects of visitor use would be similar to those described for alternative B, except that wetland-dependent species may be more sensitive to human disturbance because of the overall reduction in available habitat for those species on the refuges. The overall effect on bird species, however, would be negligible over the long term.

Alternative D

The effects of visitor use on birds would be similar to those described under alternative B, but to a greater degree. Fishing access would be allowed at two locations along the Rio Grande. The construction of new facilities would result in localized effects on habitats, and the increased presence of visitors could have negative effects on the function of the habitats and the birds that depend on them. Effects from human disturbance could occur within 50 to 100 meters from a trail or facility and would be exacerbated by the presence of dogs. Over time, disturbance could result in a simplification of the bird community as affected habitat areas are used more by generalists and less by habitat specialists. Increasing visitor numbers would magnify the effects for many bird species, as would the proposed lengthening of the time of year when access is available.

Overall, the increased visitor use and facilities would have moderate long-term negative effects on birds. While the adverse effects would be greater within the immediate vicinity of the visitor facilities, those areas would still be a small proportion of the upland habitat available on the refuges.

Bison Management

The effects of management actions related to bison are described in this section.

Alternative A

Under alternative A, the TNC grazing lease for bison on the Medano Ranch, which is privately owned but located within the Baca Refuge acquisition boundary, would be phased out, and no bison would be located on the refuge. Because the bison would be removed before we took over ownership and management, Service management actions under this alternative would have no effect on bison.

Alternative B

Under alternative B, we would use bison as a habitat management tool on the Baca Refuge and would research the feasibility of accommodating a semi-free-ranging (free-ranging within a designated area) herd on part of the Baca Refuge. Bison from neighboring herds would be used, which may or may not contribute to the greater metapopulation of the species. Implementation of these actions would allow us to better understand the benefits and drawbacks of bison on the landscape. Overall, this alternative would have a minor long-term benefit to bison as a focal species, because it would allow us to integrate the species into the landscape.

Alternative C

Under alternative C, we would periodically use bison herds for short-duration prescribed grazing to mimic natural processes. Privately owned bison from neighboring herds would be used, which would not contribute to the greater metapopulation of the species. These actions would provide limited opportunities to manage bison on the landscape, and would have negligible effects on bison as a focal species on the refuge.

Alternative D

Under alternative D, we would introduce and manage a small demonstration herd of Service-owned bison for the purposes of public viewing and interpretation. This herd would be resident on the refuge, but because the herd would be actively inventoried and managed (including pasture fencing and roundups), it would not be a semi-free-ranging herd as described under alternative B. Individual animals would be incorporated into our Service metapopulation of bison across several refuges. Implementation of this alternative would result in minor long-term benefits for bison as a focal species on the Baca Refuge because it would preserve the species on the landscape and would contribute to the Service's greater metapopulation.

Rocky Mountain Elk

The effects of our management actions on elk populations are discussed in this section.

Alternative A

Under alternative A, we would continue to work with CPW to reduce and redistribute the elk population on all the refuges, but particularly on the Baca Refuge to protect and preserve upland and riparian habitat. The population management measures could adversely affect elk in the short term but would be beneficial for the population overall. While culling inherently affects the individual animals that are killed, dispersal and harassment activities could be stressful to the other elk, especially during winter. Likewise, fencing riparian habitat to exclude elk, while good for the habitat, makes those areas unavailable to elk for foraging. Over the long term, these efforts toward reducing and redistributing the population would be beneficial to elk populations by encouraging stable and sustainable population levels based on the available habitat on the refuge. Overall, these population management efforts would result in negligible long-term benefits to elk on the refuge.

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A herd of elk appear to run in unison across the Baca Refuge.

Alternative B

Under alternative B, we would continue the elk management actions described for alternative A, but we would add a public hunting plan and an observation plan for chronic wasting disease. The effects of elk management and removal would similar as described above. There would be short-term negative effects to individual elk, with long-term benefits to the overall health of the herd. Increased monitoring for chronic wasting disease would further help the population by reducing the potential for the disease in and around the refuge. Overall, these efforts would result in minor long-term benefits to elk on the Baca Refuge.

Alternative C

Similar to alternative B.

Alternative D

Similar to alternative B.

Native Fish Populations

The effects of our management activities on the Rio Grande sucker and Rio Grande chub are described in this section.

Alternative A

Under this alternative, we would continue to study and manage habitat for native fish, including the Rio Grande sucker (which is State endangered), Rio Grande chub (which is a State species of special concern), fathead minnow, and longnose dace on the Baca Refuge. These actions would have negligible long-term benefits to these native fish species on the refuge.

Alternative B

Crestone Creek on the Baca Refuge supports Rio Grande sucker, Rio Grande chub, fathead minnow, and longnose dace. The proposed management objectives under this alternative are intended to preserve and enhance native fish habitat by restoring woody riparian and instream aquatic habitat; restoring channel morphology and function; maintaining adequate creek flows where possible; and experimenting with different gravel and cobble substrates to improve foraging for the Rio Grande sucker. These efforts would create and improve foraging, breeding, and overwintering habitat conditions for native fish. Overall, these efforts are expected to result in minor, long-term benefits to native fish species on the Baca Refuge.

Alternative C

The effects of alternative C on native fish species on the Baca Refuge would be similar to those described for alternative B, except that the benefits would likely be greater because more water would remain in the creek channels. Overall, there would be moderate, long-term benefits to native fish species on the Baca Refuge.

Alternative D

Same as under alternative B.

Other Wildlife Species

Effects of our habitat and visitor services management on other wildlife species are described in this section.

Effects of Habitat Management

Habitat management effects on other wildlife species are described below.

Alternative A

The ongoing maintenance and management of riparian, wetland, and upland vegetation on the refuges would continue to provide quality habitat for a broad range of wildlife species. In general, the existing area, condition, and function of the various habitat types would be preserved or improved. These habitat management efforts would result in negligible long-term benefits for other wildlife species on the refuges.

Alternative B

As described earlier, we would use a variety of management tools on all three refuges to preserve and improve riparian, wetland, playa, and upland habitats on the refuge. In general, the maintenance of diverse and high quality habitats would support a variety of wildlife species beyond those target species that we have outlined in our management objectives. Over time, these efforts would continue to provide habitat for a variety of general wildlife species, including small to medium-sized mammals, ungulates, reptiles and amphibians, aquatic invertebrates, and fish.

Overall, the habitat management objectives on the refuges under alternative B are expected to result in minor long-term benefits to other wildlife species.

Alternative C

The management of various habitat types would be similar to alternative B, except that created wetlands and farm fields would revert to native upland habitat, and the use of active management tools such as prescribed fire, grazing, haying, and herbicides would be tailored to mimic natural disturbance processes. Over time, these efforts would create habitat for a variety of wildlife species. Fewer habitats would be available for wetland-dependent species in some areas, while upland species may prosper in the affected areas. However, these changes are expected to result in a more diverse and resilient ecosystem on the refuge, which could offset some of the immediate effects over the long term. Overall, the habitat management objectives are expected to result in negligible long-term benefits to general wildlife species.

Alternative D

Same as alternative B.

Effects of Visitor Use Management on Other Wildlife Species

This section described the effects of visitor services activities on other wildlife species.

Alternative A

Under alternative A, we would keep our current visitor use programs and facilities on the refuges, and no new trails, roads, or facilities would be constructed. The effects of visitor use on general wildlife species would be similar to those discussed for other habitats and birds and would be based primarily on disturbance. However, many wildlife species are habitat generalists and are less vulnerable to location-specific disturbances. Overall, visitor use management under alternative A would have a negligible long-term effect on general wildlife species on the refuges.

Alternative B

The effects of visitor use management on general wildlife species are similar to those described under earlier habitat sections. Visitor access, including biking, cross-country skiing, walking, driving, limited horseback use on the Baca Refuge, limited commercial recreation, and construction of facilities, would be expanded on all three refuges, resulting in minor long-term effects in affected habitat areas, depending on the time of year, location, and magnitude of visitor use and facilities construction and maintenance. Additionally, large movements of amphibians, primarily Great Plains toad, have occurred under some environmental conditions on the Baca Refuge. During these mass movements, it would be impossible to avoid direct mortality from vehicles. These effects could be minimized by locating facilities away from the most sensitive habitats or by implementing seasonal closures.

Alternative C

Visitor use facilities and access under this alternative would be similar to the no-action alternative, except for the introduction of limited access to the Baca Refuge. The effects from visitor use would be similar to those described for alternative B, and would result mainly from facility construction and disturbance. However, these disturbances would be localized to the immediate vicinity of visitor facilities, and the overall effect on other wildlife species would be negligible and long term.

Alternative D

The effects of visitor use on other wildlife would be similar to those described under alternative B but magnified to a greater degree. There may be localized effects on habitat from the construction of new facilities and the increased presence of and disturbance from visitors. However, many wildlife species are habitat generalists and are less vulnerable to location-specific disturbances. Overall, the increased visitor use and facilities would have minor long-term effects on general wildlife species.

Mitigation for Biological Resources

Minimizing human disturbance from habitat management activities and visitor services during the nesting season would limit impacts to biological resources. This could include several measures ranging from increased visitor education, monitoring, law enforcement, seasonal closures, and re-routing trails if needed.

Cumulative Impacts on the Biological Environment

Several of the foreseeable activities described in chapter 3 could result in cumulative beneficial or negative effects on biological resources on the refuges.

The establishment and implementation of a management plan for the Rio Grande Natural Area downstream from the Alamosa Refuge would help riparian habitat and wildlife over the long term. Likewise, the monitoring, conservation, and enhancement measures associated with the San Luis Valley regional habitat conservation plan (Rio Grande Water Conservation District 2012b), along with ongoing private land conservation in the valley (particularly along the Rio Grande corridor), would be beneficial to riparian habitat and associated wildlife. The negligible to moderate benefits of riparian management activities under the proposed alternatives would result in minor cumulative benefits to riparian habitat and associated wildlife, including the southwestern willow flycatcher and focal bird species.

The planned restoration of wetlands within the San Luis Lakes system would be beneficial to overall wetland habitat and to many of the bird species that are also found on the refuges. The minor to moderate benefits of the proposed wetland management actions under the proposed alternatives would result in minor cumulative benefits to wetland systems and wetland-dependent bird species when combined with the efforts to restore the San Luis Lakes wetlands.

Development of private lands along the Rio Grande corridor, particularly within or next to woody riparian habitat areas and wetlands, would affect riparian habitat and the wildlife that depends on those areas, including the southwestern willow flycatcher, focal bird species, and general wildlife. The negligible to moderate benefits of riparian and wetland habitat management efforts on the refuges would help offset the effects of private land development elsewhere in the valley, but would not be substantial enough to result in cumulative benefits to those resources. Overall, the long-term cumulative benefits of refuge activities, when combined with private land development, would be negligible.

Over the long term, regional water management efforts in the San Luis Valley, including new State water management rules and the establishment of ground water management subdistricts, are expected to result in localized changes in some wetland and riparian habitat areas because of changes in water use and management. While some habitat areas (such as natural flowpaths) would receive more water, other areas (such as tailwater areas) may receive less water; the long-term effects of these changes on habitat are not certain. The benefits from refuge management alternatives to riparian and wetland habitats, when combined with the uncertain effects of water management policies and programs, would likely result in negligible long-term cumulative benefits on those resources.

5.6 Effects on Visitor Services

Our policies for wildlife-dependent recreational activities emphasize quality hunting and wildlife-viewing opportunities. Quality opportunities have the following elements: (1) safety and compliance with applicable laws; (2) reduced conflicts with wildlife and habitat goals and other public uses; (3) accessibility for all; (4) resource stewardship; and (5) reliable and reasonable opportunities to experience wildlife (FWS 2006f). These elements were taken into consideration in describing the potential effects of the alternatives on visitor services.

Effects on Hunting

The effects of our management actions on hunting are discussed, including access, opportunities for hunting, safety, and other users, as well as how our habitat and management programs, including water management and wilderness recommendations, would affect the hunting program.

Alternative A

Long term, there would be few changes from current hunting opportunities offered on the refuge complex. The hunting areas would remain the same for the Monte Vista and Alamosa Refuges. (Refer to figures 13 and 14 in chapter 3.) Hunters could hunt waterfowl, upland game birds, and some small game. Recreational big game hunting would not be allowed on the refuge complex. Baca Refuge would not be open to hunting.

Short term, to the extent possible with the current drought conditions, we would flood some wetlands to help breeding and migrating ducks. Consequently, we would expect hunting levels to fluctuate between 800 and 1,000 hunters on both the Alamosa and Monte Vista Refuges. In the mid- and late 1990s, there were many more hunters than there are now. Because of safety concerns and the reduced quality of hunting, we went to a permit-type system that was eventually eliminated because of fewer waterfowl due to drought conditions. In recent years, conditions have been much drier in the San Luis Valley, and fewer ducks have been breeding in and migrating through the area. The first few weekends of the hunting season attract local hunters who are hunting locally produced ducks (ducks hatched and raised in the valley). Once fall migration starts, waterfowl hunting picks up, but weather further north and local water conditions strongly influence the number of ducks on the refuges and, as a result, the number of hunters.

Long term, we would not expect the number of waterfowl hunters to increase on the refuges without more water or new opportunities. In recent years, hunting participation has been decreasing both nationwide and in Colorado (Larson et al. 2013; Willoughby 2013). The 2011 National Survey of Fishing, Hunting, And Wildlife-Associated Recreation compared figures from 2001 through 2011 and found the overall number of hunters increased 9 percent from 2006 to 2011, primarily because of a 29 percent increase in big game hunting days. The 2011 survey also acknowledged that these findings run counter to the downward trends documented in earlier surveys (DOI, FWS, and Department of Commerce U.S. Census Bureau 2011).

In the short term, any indirect negative effects on waterfowl hunting would be negligible to minor depending on water availability. Generally, we would continue to manage the wetlands and uplands on the Monte Vista and Alamosa Refuges according to the management policies detailed in the 2003 CCP (FWS 2003). This includes flooding wetlands to provide invertebrate food sources for breeding and migrating ducks and geese. Even with the expected changes in ground water rules and regulations, we would keep our water rights and manage our existing financial and water resources to support wildlife habitat.

In the long term, as discussed under "Habitat and Wildlife" in chapter 4, section 3, we would not be able to sustain the integrity, productivity, and function of many of the wetland habitats, given both the dynamic climatic variations that we continue to experience and the limited budget for pumping. Changes in ground water rules and regulations under Colorado State water law would affect the future volume and timing of water availability on the refuges in part because of financial constraints due to the costs of augmenting well water. Because there would be less water available, this would have the direct effect of reducing duck production on the refuges. Indirectly, the quality of waterfowl hunting on the Monte Vista and Alamosa Refuges would likely decline because of reduced habitat and fewer ducks and geese for hunters to take. Lack of water would result in negative impacts for waterfowl hunting that would range from minor to major, depending on varying climatic conditions and precipitation from year to year.

We would manage the upland areas in the same manner as we have been, and we would expect few impacts to small-game hunters under this alternative.

Under alternative A, we would not recommend any areas for wilderness study. Since public hunting is not allowed on the Baca Refuge, there would be no indirect impacts on hunting.

Overall, in the long term, continuing the management plans of alternative A would result in minor to moderate negative impacts on hunting opportunities throughout the refuge complex.

Alternative B

For waterfowl and small game hunting, the hunt boundaries would remain the same as under alternative A on the Alamosa and Monte Vista Refuges. (Refer to figures 16 and 17 in chapter 3.) With the opening of the Monte Vista and Alamosa Refuges to public dispersal hunts and the opening of the Baca Refuge to small and big game (primarily elk but could include mule deer if populations increase) hunting, opportunities for small and big game hunting would increase by a moderate amount over the long term. (Refer to figures 16, 17, and 18 in chapter 3 and tables 20 and 21.)

We would continue to reliably provide water to wetland areas to support foraging and breeding habitat for waterfowl within any existing funding limitations for pumping water. In the short term, the direct effects of our water management would result in negligible to minor effects on waterfowl hunting. In the long term, some existing wetland areas would not support breeding waterfowl every year as we strategically move toward restoring natural flow patterns. For example, on the Alamosa Refuge we would not be holding as much water in the northern part of the refuge; instead, we would move water through the northern wetlands to the southern part of the refuge, where there use to be more wetlands associated with the Rio Grande. We would apply this strategy to a lesser degree on the Monte Vista Refuge by applying water as a sheet flow where practical. This would help to reduce potential negative effects on local duck production on the refuge and subsequently reduce the indirect effects on waterfowl hunting.

Similar to alternative A, the refuges would also be affected if there is less water in areas near the refuges because of drought and climate change. It is uncertain what the indirect effects of the new regulations requiring augmentation of well water would have on water tables and waterfowl hunting as a whole in the San Luis Valley. It is difficult to project with any certainty the direct long-range effects of our water management, given the annual variability of precipitation, climate change, and other factors. BOR's recent climate risk assessment of the upper Rio Grande watershed, including the Sangre de Cristo and San Juan Mountains (BOR 2013b), predicts that there will be one-third less water overall as a result of climate change. Projections are that annual precipitation will be quite variable over the next century in the upper Rio Grande (BOR 2013b). Because water availability would be better in some years than others, any indirect negative impacts on waterfowl hunting would likely vary from minor to major depending on the year.

We would preserve and improve the habitat diversity of upland native shrubs and short-grass communities on the Monte Vista and Alamosa Refuges. In some areas of marginal artificial wetlands, we would begin native shrub restoration that would return these areas to upland habitat. In the long term, these efforts would provide more opportunities for small game hunting, particularly if our efforts to reduce invasive species are successful. This would result in minor to moderate indirect benefits for small game hunters in the long term.

Opening the Baca Refuge to small and big game hunting would improve overall hunting opportunities across the refuge complex. Waterfowl hunting would not be allowed on the Baca Refuge. Opening Baca Refuge to big game hunting could result in elk dispersing onto adjacent lands, which could indirectly benefit hunters if elk were pushed north on to the Rio Grande National Forest or other private lands where hunting is allowed. Close coordination with CPW, NPS, and local landowners would be necessary to limit habitat impacts on adjacent lands.

Opening traditional hunting areas of the Monte Vista and Alamosa Refuges to nonconsumptive users would have negligible direct effects on hunters. Any conflicts that arose between user groups would be managed as needed through education, signage, or limited closures during peak hunting periods. This

Table 20. Public access on Refuge Complex by alternative.

Availability of access	*Alternative A*	*Alternative B*	*Alternative C*	*Alternative D*
Monte Vista National Wildlife Refuge				
Miles of roads along boundary or through refuge, including auto tour route and seasonal auto tour route*	24	24	24	28
Miles of trails available for hunters only	8.7	0	0	0
Miles of trails and roads available for biking and walking (July 15-Febuary 28) **	0	8.7	8.7	8.7
Miles of nature trails (interpretive)	0.24	1.7	0.24	3.5
Miles of auto tour route	2.5	2.5	2.5	2.5
Miles of seasonal auto tour route	0	0	0	4.1
Alamosa National Wildlife Refuge				
Miles of roads available year round (along boundary or through refuge, including auto tour route)*	21	24	21	27
Miles of trails available for hunters only	7.3	0	0	0
Miles of trails and roads available for biking and walking (July 15-Febuary 28)**	0	5.4	5.4	5.4
Miles of nature trails (interpretive)	2.6	9.0	2.6	5.4
Miles of road open for hunters only	3	0	0	0
Miles of auto tour route open year around	3.2	5.4	5.4	5.4
Miles of seasonal auto tour route available	0	0	0	3.6
Baca National Wildlife Refuge				
Miles of roads along boundary or through refuge, including auto tour route*	27	41	27	41
Miles of trails open**	0	3	0	6
Miles of nature trails (interpretive)	0	7	0	7
Miles of auto tour route	0	14	0	14
Miles of seasonal auto tour route (non-motorized modalities allowed)	0	6	0	28

*Includes county, State, or other local roads along the boundary or through the refuge for any length; all mileages rounded to nearest mile.

** Trails could overlap with refuge road access, as depicted in alternatives figures 13–24.

Table 21. Comparison of access, visitation, and facilities of the CCP alternatives.

Visitation	*Alternative A*	*Alternative B*	*Alternative C*	*Alternative D*
Hunting visits	1,000 Monte Vista and Alamosa Refuges only	Expand over A: open the Baca Refuge to small game and big game hunting; expand hunting on the Alamosa Refuge to include big game.	Same as B but would take longer to implement (50 percent by year 10)	Same as B but expand opportunities for young people
Fishing visits	100–150*; youths only	Same as A.	Same as A.	Same as A plus allow walk-in fishing along Rio Grande south of parking area #5 and Chicago Dam if safety is addressed
Wildlife observation, photography, and Interpretation	15,000–17,000 nonconsumptive days on the Alamosa and Monte Vista Refuges	Increase annual visitation 15–25 percent on the Alamosa and Monte Vista Refuges (up to 4,000 more visitors). Open the Baca Refuge to public use (about 1,000–3,000 initially); expand over 15 years to 10,000–15,000.	Similar to alternative A with limited opening of the Baca Refuge.	Increase visitation on the Alamosa and Monte Vista Refuges by 25–40 percent (4,000–6,000); Expand on the Baca Refuge to 15,000–20,000
Interpretation and environmental education	Maintain limited environmental education programs	Same as A plus: provide minimum 2 school or teacher training groups annually By year 5, host programs and activities 6 times per year at the Baca Refuge	Similar to alternative A Offer limited tours at the Baca Refuge (10 per year); host limited environmental education programs	Same as B plus: within 10 years, expand environmental education to 20 school groups annually. Offer regular interpretive programming. Establish San Luis Valley-wide tour routes to highlight the 3 refuges; Expand environmental education programs on the Baca Refuge
Visitor Facilities		Improve facilities; increase public access on the Monte Vista and Alamosa Refuges. Build new visitor center at the Monte Vista Refuge and new interpretive displays at the Alamosa Refuge. Expand tour route on Alamosa to access Bluff Overlook. All refuges: provide trail connections to local communities		Build 4+ more miles of trail along Rio Grande to provide better north and south connections

Table 21. Comparison of access, visitation, and facilities of the CCP alternatives.

Visitation	*Alternative A*	*Alternative B*	*Alternative C*	*Alternative D*
Outreach		Develop outreach plan; increase visibility of refuge complex through better signing and information; develop new brochure for refuge complex that highlights resources and opportunities. Improve the refuge complex Web site. Strengthen links with area tourism centers	Similar to alternative B	Increase efforts over alternatives B and C because of 2 outdoor recreation planners and 1 environmental education specialists and more seasonal staff. More information sharing events.
Access (vehicles and non-motorized modalities)	On the Alamosa and Monte Vista Refuges, limit access by vehicles to designated routes. Allow hunters walking and road access in designated hunting areas. Allow other visitors walking access on established nature trails. Baca Refuge is not open for public use	On the Alamosa Refuges and Monte Vista Refuges, open existing hunting areas for biking and walking from about July 15-February 28 and expand nature trails. On the Baca Refuge, allow for a variety of opportunities for year round access and some seasonal-only access for motorized vehicles and non-motorized modalities (walking, biking, horse).	Open existing hunting areas for biking and walking from about July 15-February 28. Allow for limited access on the Baca Refuge.	Similar to alternative B, but access would be expanded to include more seasonal access opportunities including fishing on the Alamosa Refuge.
Total Visitation	15,000–20,000	Alamosa and Monte Vista Refuges: increase visitation by 15–25 (4,000) to 19,000–24,000 Baca Refuge-By year 5, 1,000–3,000 visits; increase to 10,000–5,000	Same as alternative A- 15,000–20,000 Baca Refuge-Over 15 years 1,000–3,000 visits	Alamosa and Monte Vista -increase visitation by 25–40 to 21,000–26,000 over 15 years. Baca Refuge-By year 5, 1,000–3,000 visits; increase to 10,000–5,000 or higher

would be similar for the Baca Refuge. Potential conflicts would be assessed and addressed as needed.

Under alternative B, on the Baca Refuge, the southeastern portions of the refuge (about 13,800 acres) would be recommended for a wilderness study area. Some hunters would view this as enhancing their hunting experience while others may desire better access for hunting or game retrieval.

Overall, implementation of alternative B would result in in a moderate, long-term benefit for hunting on the refuge complex.

Alternative C

Similar to alternative B, in the long term, opening the Alamosa and Monte Vista Refuges to limited public dispersal hunts and opening the Baca Refuge to small and big game (primarily elk but could include deer if harvest is needed) hunting would increase overall opportunities for hunting across the refuge complex. It would take longer to open areas on the Baca Refuge (5 years versus 3 years under alternative B for archery, and 10 years versus 7 years for big game across the Baca Refuge), in part because there would be less emphasis on visitor use under this alternative.

In the long term, depending on the restoration timeline, converting more areas from wetlands to uplands on the Monte Vista and Alamosa Refuges would likely indirectly affect waterfowl hunting to a greater degree than under alternatives A or B. Water application on the Monte Vista Refuge would be restricted to the Spring Creek and Rock Creek drainages. On the Alamosa Refuge, water would be restricted to the deepest natural sloughs and oxbows formed by old channels of the Rio Grande to provide foraging and breeding habitat for waterfowl. During the fall, only the deepest wetland areas would hold water and most of the natural wetlands would be dry.

Restoring upland areas that had been converted to wetlands or farmland on the Monte Vista Refuge would increase opportunities for small game hunters, particularly if goals for shrub cover and invasive weeds were met.

Similar to alternative B, the southeastern portion of the Baca Refuge (about 13,800 acres) would be recommended as a wilderness study area. Some hunters would view this as enhancing their hunting experience while others would be negatively affected by lack of easy access.

Overall, this alternative would result in a negligible to minor long-term benefit for hunting opportunities and experiences across the refuge complex.

Alternative D

As under alternative A, the hunt boundary for waterfowl and small game hunting would remain the same for the Monte Vista and Alamosa Refuges. (Refer to figures 22 and 23 in chapter 3.) Similar to alternatives B and C, opening the Monte Vista and Alamosa Refuges to limited dispersal big game (primarily elk but could include deer if harvest is needed) hunts and opening the Baca Refuge to small and big game hunting would increase overall opportunities for diverse, quality hunting opportunities across the refuge complex by a moderate to major amount (figure 24 in chapter 3). There would be new opportunities and experiences for young hunters, accessible hunting facilities and access would be improved, and, if needed, new facilities would be added. Similar to alternative A, the direct effects of our habitat and water management would indirectly affect opportunities for waterfowl hunting over the long term.

Similar to alternatives B and C, the southeastern portion of the Baca Refuge (about 13,800 acres) would be recommended as a wilderness study area. Some hunters would view this as enhancing their hunting experience while others would be negatively affected by lack of easy access.

Overall, implementation of alternative D would result in a moderate long-term benefit for hunting opportunities across the refuge complex.

Effects on Fishing

Fishing opportunities in the refuge complex are limited.

All Alternatives

Under all alternatives, we would continue to promote Kid's Fishing Day on the Monte Vista Refuge, which is geared toward environmental education. Under alternatives A, B, and C, there would be no new opportunities for fishing in the refuge complex. Under alternative D, walk-in fishing access along the Rio Grande on the Alamosa Refuge would be allowed south of parking area 5. If practical, a safe access point and pier would be developed to allow fishing at the Chicago Dam on the Alamosa Refuge. Future habitat restoration in riparian areas may necessitate limiting visitor use along the river, which would in turn limit opportunities for fishing.

Implementation of alternatives A, B, or C would result in negligible to minor impacts to anglers across the refuge complex. Implementation of alternative D would result in a minor, long-term benefit for fishing enthusiasts on the refuge complex.

Effects on Wildlife Observation, Photography, and Interpretation

This section addresses effects on wildlife observation, photography, and interpretation programs, including opportunities and facilities. Service policy encourages refuges to provide quality opportunities for observing and photographing wildlife (FWS 2006c, f).

Alternative A

In the short and long term, there would be limited opportunities and experiences available for wildlife observation, photography, and interpretation on the Monte Vista and Alamosa Refuges. (Refer to figures 13 and 14, chapter 3.) The 2.5-mile auto tour route on the Monte Vista Refuge and the 3.2-mile auto tour route on the Alamosa Refuge would continue to provide for wildlife viewing. (Refer to table 20 below.) The 0.24-mile nature trail on the Monte Vista Refuge and the nearly 3 miles of nature trail on the Alamosa Refuge also provide for self-guided interpretation. On the Monte Vista Refuge, about 23.6 miles of public or refuge roads along the refuge boundary or through the Monte Vista Refuge provide places to view refuge resources. On the Alamosa Refuge, there are a little more than 21 miles of public or refuge roads that traverse the boundary or go through the refuge and provide viewing opportunities, including those from Bluff Overlook along the eastern boundary. The Bluff Overlook is accessible only from a lengthy, rough, and disjointed route along the northern and eastern boundaries.

Without a staff person dedicated to visitor services, it is unlikely that we would increase the numbers of nonconsumptive users at the refuges, improve the quality of the visitor service programs, or educate visitors about the Service and the Refuge System. The existing visitor center at the Alamosa Refuge is staffed only part-time and has limited interpretive exhibits. Even though the Monte Vista Refuge receives the most visitors of the three refuges, in part because of the crane festival and Kid's Fishing Day, there is no visitor contact station at the refuge. Interpretive signs are found only along the auto tour route, at a few overlooks, and along the 0.24-mile nature trail.

On the Monte Vista Refuge, our habitat management program would have negligible indirect effects in the short term on visitors who come to view sandhill cranes, waterfowl, and other birds. Water and small grains would be provided in late winter on the Monte Vista Refuge. In turn, this would continue to attract and provide food for sandhill cranes and waterfowl. Long term, similar to the discussion under hunting for alternative A, there would be indirect negative effects for nonconsumptive visitors. Nonconsumptive visitors will be less likely to visit the refuge complex if wetland habitat for waterfowl and sandhill cranes is limited because of drought, climate change, or funding shortages that make pumping water prohibitively expensive.

Due to drought and climate change, changes in water management regulation combined with the limited areas where nonconsumptive visitors can currently go, continued implementation of alternative A would result in negligible to moderate negative impacts for nonconsumptive wildlife enthusiasts on the refuge complex.

Alternative B

On the Monte Vista Refuge, the nature trail would be expanded to nearly 2 miles beyond the existing 0.24-mile trail. On the Alamosa Refuge, 6.4 more miles of interpretive nature trails would be available for wildlife observation and photography, including a trail link to the refuge from the town of Alamosa (table 20, figure 16). By opening the existing hunting areas on the Monte Vista and Alamosa refuges to biking and walking, more opportunities would be available for wildlife viewing and photography from July 15 to the beginning of the breeding season at the end of February. On the Alamosa Refuge, the auto tour route would be extended to the east to connect to the Bluff Road (County Road S116). Together, these changes would provide moderate to major benefits for nonconsumptive users of the refuges.

Trail links to the nearby communities of Monte Vista and Alamosa would facilitate access for visitors and increase visitation. The building of a visitor center and refuge headquarters would increase the visibility of the Monte Vista Refuge and would indirectly increase the number of visitors enjoying wildlife observation and photography on refuge trails and roads. Having a regularly staffed visitor center would help provide interpretation on the Monte Vista Refuge.

Similar to the discussion above under hunting, in the long term, changes in habitat management to restore more natural flow patterns in some areas would indirectly reduce opportunities to view large numbers of waterfowl, shorebirds, sandhill cranes, and other waterbird species on the Monte Vista and Alamosa Refuges, particularly during periods of severe drought. Opening other areas of the refuges for biking and walking outside of the breeding period would increase management flexibility by providing other areas where waterbirds and other wildlife could be viewed during severe droughts and provide an opportunity to communicate other interpretive themes and messages. The installation of carefully designed and placed viewing blinds or even mobile blinds would enable visitors to view more wildlife while limiting disturbance to waterbirds.

The Baca Refuge would be opened to the public for wildlife viewing and photography. In combination with a new visitor center at the Monte Vista Refuge, this would significantly increase our ability to reach out to new audiences and would result in moderate to major indirect long-term benefits for both the Service and visitors to the refuge complex and the San Luis Valley. On the Baca Refuge, opportunities would initially be limited as visitor facilities are slowly developed, partly because of funding constraints. Long term (over 15 years), we would develop an auto tour route, install wayside exhibits, and develop interpretive and walking trails around the headquarters area and the Cottonwood Camp area. We would work with the NPS and other agencies to communicate our messages and those of our partners in the San Luis Valley.

Safety is an important consideration for all visitors. The ongoing hunting program would have negligible impacts on the safety of nonconsumptive visitors. However, as needed, signs, education, or closure notices would be used to reduce potential safety concerns.

Implementation of alternative B would result in minor to moderate long-term benefits for nonconsumptive users across the refuge complex.

Alternative C

Under alternative C, similar to alternative B, trails on the Alamosa and Monte Vista Refuges that are currently open only to hunters would be opened from July 15-February 28 to all users, providing more opportunities for visitors who want to walk and bike on the refuges. The addition of an outdoor recreation planner would also enable the refuge complex to provide more visitor services and programs. Otherwise, there would be few changes from alternative A. The implementation of alternative C could also result in the greatest negative impacts for visitors who wish to view wildlife, particularly on the Monte Vista Refuge, where the elimination of the Monte Vista farm fields would result in moderate to major negative impacts for viewing sandhill cranes on the refuge. Because Alternative C would emphasize following natural flow patterns, wildlife viewing opportunities could be further limited.

Although opening the hunting areas on the Monte Vista and Alamosa Refuges to nonconsumptive users and the addition of better visitor services would provide minor benefits for nonconsumptive users, the implementation of alternative C could result in minor to moderate long-term negative impacts for nonconsumptive users across the refuge complex overall as a result of less wildlife viewing opportunities as existing wetlands dry up due to restoration activities.

Alternative D

Opportunities for nonconsumptive users would be greatest under alternative D. There would be more visitor access available under this alternative than under alternative B, particularly on the Baca Refuge, where users could have seasonal access to the interior areas of the refuge. The auto tour routes on the Monte Vista and Alamosa Refuges would be expanded to include seasonal routes as well. The addition of two outdoor recreation planners and an environmental education specialist would greatly improve the visitor services program.

Overall, the implementation of alternative D would result in moderate to major long-term benefits for nonconsumptive users on the refuge complex.

Effects on Environmental Education

This section discusses the impacts to environmental education.

Alternative A

There would continue to be limited environmental education opportunities offered within the refuge complex. We would continue to work with our Friends group to support the Monte Vista Crane Festival, Kid's Fishing Day, and the Kids Crane Festival. Without money for an outdoor recreation plan-

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Environmental education is a priority public use on national wildlife refuges.

ner, education programs would continue to be sporadic.

Alternative B

Hiring an outdoor recreation planner would enhance the environmental education program for the refuge complex by a minor to moderate amount. Opening the hunting areas to biking and walking on Alamosa and Monte Vista Refuges and opening the Baca Refuge to visitors would greatly expand the area and availability of where environmental education programs could take place, resulting in a long-term moderate benefit for environmental education in the refuge complex.

Alternative C

Similar to alternative B, hiring an outdoor recreation planner would enable us to enhance the education program for the refuge complex. There would be less focus on environmental education than under alternative B, but because we would be able to provide more consistent programs and there would be more areas where programs could take place, there would be minor long-term benefits for environmental education in the refuge complex.

Alternative D

Hiring two outdoor recreation planners and an environmental education specialist as well as increasing access and improving facilities would result in a moderate to major long-term benefit for environmental education in the refuge complex.

Effects on Outreach

Under alternative A, we would continue limited outreach activities including public presentations, working with the Friends group, putting out news releases, conducting tours, and attending meetings with county commissioners and nongovernmental organizations. We would increase our outreach activities under alternatives B, C, and D largely through the addition of public use staff, a refuge manager for Monte Vista, and other biological support. This would enable us to maintain and strengthen existing outreach activities. The long-term benefit would be moderate under alternative B, minor under alternative C, and moderate to major under alternative D.

Cumulative Impacts on Visitor Services

None of the proposed alternatives would result in cumulative impacts on hunting, fishing, or outreach when combined with the activities described under chapter 3, "Foreseeable Activities." Implementation of the Sangre de Cristo Natural Heritage Area Management Plan would improve overall visitation, education, and tourism in the region. Within this context, implementation of the proposed facilities and programs to support wildlife observation, photography, interpretation, and outreach would result in negligible cumulative benefits over the long term.

5.7 Effects on Special Management Areas

Effects on the Sangre de Cristo Conservation Area, the proposed San Luis Valley Conservation Area, recommended wilderness areas, and the Sangre de Cristo Natural Heritage Area are discussed.

Conservation and Natural Heritage Areas

Existing and proposed conservation areas are discussed in this section.

All Alternatives

None of the alternatives would result in any direct effect on these areas or the values for which these areas were set aside. The cultural, historic, and natural values of these areas would be protected and enhanced. (Refer to the discussion of cultural resources, including the Pedro Trujillo homestead, below.) Partnerships and collaboration are key elements which indirectly help these areas.

Wilderness Review

As required by our planning policy, we conducted a review of potential wilderness values and characteristics of the refuge complex (refer to appendix E).

Potential wilderness areas:

- are at least 5,000 acres or are of sufficient size to make practical their preservation and use in an unimpaired condition;
- appear to be affected primarily by the forces of nature with the human imprint substantially unnoticeable;
- have outstanding opportunities for solitude;
- have outstanding opportunities for a primitive and uncontrolled type of recreation; and
- contain ecological, geological or other features of scientific, educational, scenic, or historic value.

Our review found that only the southeastern portions of the Baca Refuge met these criteria.

Alternative A

Under alternative A, we assumed that no areas within the refuge complex would be recommended for further wilderness study. There would be no further protections afforded to these lands other than our refuge management policies and the guidance found in the CCP. Depending on the actions of future refuge managers or other outside factors, existing wilderness values and characteristics could be affected.

Alternatives B, C, and D

Under alternatives B, C, and D, the southeastern portion of Baca Refuge would be managed as a wilderness study area until further action was taken by the U.S. Congress. The wilderness values and characteristics as described in appendix E would be protected, resulting in moderate long-term benefits for wilderness values and characteristics.

Cumulative Impacts on Special Management Areas

None of the refuge management alternatives would result in negative impacts to the Sangre de Cristo National Heritage Area or nearby designated or recommended wilderness areas. The recommendation for protecting the wilderness values and characteristics on parts of the Baca Refuge would result in moderate benefits to the overall wilderness values and characteristics of the Great Sand Dunes ecosystem.

5.8 Effects on Cultural Resources

Through the combined efforts of different agencies, organizations, and individuals, many prehistoric and historic sites have been documented in the San Luis Valley. However, many of the refuge complex's resources have not been surveyed. Formal investigations have been sporadic, and there is still a lot we do not know about these resources.

All Alternatives

Under all alternatives, we would continue to adhere to cultural resource laws such as Section 106 of the National Historic Preservation Act, the Archaeological Preservation Act, and the Native American Graves Protection and Repatriation Act. With the help of the Service cultural resource staff, we would avoid adverse effects on cultural resources. All alternatives would adhere to the spirit and intent of the Memorandum of Understanding with various tribes for the treatment and disposition of all Native American human remains, associated and unassociated funerary objects, and other sacred objects. (Refer to chapter 4, section 4.6, Tribal Coordination.)

Some of the activities outlined for each alternative have the potential to negatively affect cultural resources, either by direct disturbance (such as through ground-disturbing activities during construction), or by long term exposure to the elements. The presence of cultural resources, including historic properties, would not prevent a Federal undertaking or projects, but any undertaking would be subject to Section 106 of the National Historic Preservation Act and other laws protecting cultural resources.

Effects of Alternatives B, C, and D

The differences between the potential effects of the different action alternatives on cultural resources are nuanced. With all alternatives, any undertaking that disturbs the soil or alters buildings or structures over 50 years of age would be reviewed under Section 106 of the National Historic Preservation Act. Most of our habitat restoration work would involve modifying existing infrastructure. While we would need to evaluate any structures for their historical significance before disturbing them, we would not generally be initiating large ground-disturbing activities. Most of our work would be focused on opening up natural flow patterns by removing dikes, modifying structures, and restoring upland areas on formal agricultural areas. Potential adverse effects on historic

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The former Baca cattle headquarters is an eligible historic district on the Baca Refuge.

properties would be avoided when possible and resolved through consultation.

We would provide the Service cultural resource staff with a description and location of all projects, activities, routine maintenance, and operations that could cause ground disturbance or affect structures or buildings. The Service cultural resource staff would analyze the potential to affect historic properties and enter into consultation with the State Historic Preservation Officer and other parties as necessary. We would protect all known gravesites.

All the action alternatives would offer more educational opportunities and involve more work with our partners to accomplish preservation and research objectives. For example, we would pursue establishment of a National Register Historic District at the two Baca Ranch complexes. We would provide guided tours and collaborate with tribal representatives to preserve sites and collections. As a result, cultural resources would receive greater protection.

Under alternatives B and D, known sites and sensitive areas would get more law enforcement protection. Under alternative C, because natural processes would be emphasized, we would likely remove some non-significant structures and buildings that are not needed for refuge operations or are intrusive to historic districts or landscapes.

As compared with alternative A, under alternatives B, C, and D, there would be better planning and more survey work so there would be increased protection and preservation of cultural resources. Development of a stepdown plan for cultural resources would be beneficial, particularly if it were integrated with habitat management plans. Additional cultural resource surveys would help identify areas with a moderate to high potential for cultural resources and thereby enable us to make better planning and public access decisions.

Visitors who are interested in the history and prehistory of the refuge complex would benefit from an increased emphasis on cultural resource interpretation and preservation.

Conclusion

We would continue to follow all cultural resource laws for any projects on the refuge. Under alternatives B and D, we would increase our protection efforts through better planning, survey work, and law enforcement. Alternative C would likely not require as much law enforcement. Overall, the long-term effects on cultural resources would be negligible to minor with minor beneficial effects with increased law enforcement and stabilization and surveys.

Mitigation for Cultural Resources

We do not foresee any of our activities requiring additional mitigation, but for any of our management actions, any mitigation measures would be addressed through our Service cultural resource staff and with the State Historic Preservation Officer under a programmatic agreement.

Cumulative Impacts on Cultural Resources

Implementation of the Sangre de Cristo National Heritage Area management plan would improve interpretation and help cultural resources preservation in the San Luis Valley. This, in combination with the proposed measures under all alternatives, would result in negligible to minor cumulative benefits to cultural resources over the long term.

5.9 Effects on the Socioeconomic Environment

Based on the regional economic setting described in chapter 4 (section 4.7), the methods used to conduct a regional economic impact analysis are detailed below, followed by an analysis of the final CCP management strategies that could affect stakeholders, residents, and the local economy. The management activities of economic concern in this analysis are:

- Revenue sharing payments;
- Refuge complex staff salary spending;
- Refuge complex purchases of goods and services within the local economy; and
- Spending in the local economy by visitors to the refuges.

Methods for a Regional Economic Impact Analysis

Economic input-output models are commonly used to find out how economic sectors may be affected by demographic, economic, and policy changes. The economic impacts of the management alternatives for the refuge complex were estimated using IMPLAN (Impact Analysis for Planning), a regional input-output modeling system developed by the USFS. IMPLAN is a computerized database and modeling system that provides a regional input-output analysis of economic activity in terms of 10 industrial groups involving more than 400 economic sectors (Olson and Lindall 1999). The IMPLAN model draws on data collected by the IMPLAN Group LLC from multiple Federal and State sources, including the Bureau of Economic Analysis, the Bureau of Labor Statistics, and the U.S. Census Bureau. The year 2009 IMPLAN data profiles for Alamosa, Costilla, Rio Grande, and Saguache Counties were used in this study. The IMPLAN county-level employment data estimates were found to be comparable to the U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System data for the year 2009 (Olson and Lindall 1999).

Regional economic impact analyses capture the complex interactions of consumers and producers of goods and services in local economies. Economies are complex webs of interacting consumers and producers, in which goods produced by one sector of an economy become inputs to another, and the goods produced by that sector can become inputs to still more sectors. A change in the final demand for a good or service can generate a ripple effect throughout an economy. For example, if more visitors come to an area, local businesses will hire extra labor and get supplies to meet the increase in demand for more services. The income and employment resulting from visitor purchases from local businesses represent the direct effects of visitor spending within the economy. Direct effects measure the net amount of spending that stays in the local economy after the first round of spending; the amount that doesn't stay in the local economy is termed a leakage (Carver and Caudill 2007). To increase supplies to local businesses, input suppliers must also increase their purchases of inputs from other industries. The income and employment resulting from these secondary purchases by input suppliers are the indirect effects of visitor spending within the economy. Employees of the directly affected businesses and input suppliers use their incomes to buy goods and services. The resulting increased economic activity from new employee income is the induced effect of visitor spending. The indirect and induced effects are known as the secondary effects of visitor spending. Multipliers (also known as response coefficients) capture the size of the secondary effects, usually as a ratio of total effects on direct effects (Stynes 1998). The sums of the direct and secondary effects describe the total economic impact of visitor spending in the local economy.

Regional economic effects from the IMPLAN model are reported for the following economic measures:

- Employment represents the change in the number of jobs generated in the region from a change in regional output. IMPLAN estimates for employment include full time, part time, and temporary jobs.
- Labor income includes employee wages and salaries, including the income of sole proprietors and payroll benefits.
- Value added measures contribution to Gross Domestic Product (GDP). Value added is equal to the difference between the amount an industry sells a product for and the production cost of the product, and is thus the net of intermediate sales.

This CCP guides long-range management direction to achieve the refuge complex purposes over a 15-year timeframe. The economic impacts reported here are yearly in 2013 dollars. Large management changes often take several years to achieve. The estimates reported for alternatives B, C, and D represent the final economic effects after all the changes in management have been implemented.

Impacts of Current and Proposed Management Activities

The impacts from refuge revenue sharing payments, refuge purchases of goods and services within the local economy, and the effects of visitor expenditures are discussed.

Impacts from Refuge Revenue Sharing Payments. We make revenue sharing payments to the counties for the land that is under our administration. Under provisions of the Refuge Revenue Sharing (RRS) Act, local counties receive an annual payment for lands that have been bought by full fee-title acquisition by the Service. Payments are based on the greater of 75 cents per acre or 0.75 percent of the fair market value. The exact amount of the annual payment depends on Congressional appropriations, which in recent years have tended to be substantially less than the amount required to fully fund the authorized level of payments. For fiscal year 2012, the four counties that contain portions of a refuge each received a payment: Alamosa County received $17,797, Costilla County received $334, Rio Grande County received $24,304, and Saguache County received $32,805. Table 22 shows the annual impacts of the $75,240 received by the local area in RRS payments. The RRS payments generate an estimated total impact of 1 job, $20,700 in labor income, and $28,200 in value added annually to the local four-county area.

Table 22. Annual impacts of refuge revenue-sharing payments.

	Employment (number of full and part-time jobs)	*Labor income ($2013)*	*Value added ($2013)*
All Alternatives			
Direct effects	1	$17,700	$22,500
Secondary effects	0	$3,000	$5,700
Total effects	1	$20,700	$28,200

Effects of Refuge Staff Salary Spending within the Local Economy

Refuge complex employees live and spend their salaries on daily living expenses in the local area, thereby generating impacts within the local economy. Household consumption expenditures consist of payments by individuals and households to industries for goods and services used for personal consumption. The IMPLAN modeling system contains household income consumption spending profiles that account for average household spending patterns by income level. These profiles also capture average annual savings and allow for leakage of household spending to outside the region. The IMPLAN household spending pattern for households earning $50,000–75,000 dollars per year was used to reflect the average salary of full-time permanent employees for the refuge complex.

The current approved staff for the refuge complex consists of 14 employees (including permanent, part-time, and seasonal positions). Refuge complex staff is expected to increase to 34 employees under alternative B, 35 employees under alternative C, and 43 employees under alternative D (including full time, part-time, and seasonal positions). For a complete description of positions, see table 7 in chapter 3.

Refuge complex staff estimate that current annual salaries total approximately $1,099,300 under alternative A. Staff expenses are expected to increase to approximately $1,724,200 under alternative B, $1,275,000 under alternative C, and $1,985,700 under alternative D. The economic impacts associated with refuge complex employees spending their salaries in the local four-county area are summarized in table 23. These impacts include only the secondary effects of non-refuge jobs created as refuge complex employees spend their salaries in the local four-county area.

For alternative A, it is estimated that salary spending by refuge complex staff would generate a secondary effects of 5 jobs, $146,900 in labor income, and $294,000 in value added annually in the local economy.

Under alternative B, the annual impact of salary spending would increase to 7 jobs, $230,400 in labor income, and $461,800 in value added.

Under alternative C, there would be secondary effects of 5 jobs, $170,400 in labor income, and $341,500 in value added annually.

Under alternative D, there would be 8 jobs, $265,300 in labor income, and $531,800 in value added annually.

Table 23. Annual impacts of salary spending.

	Employment (number of full and part-time jobs)	*Labor income ($2013)*	*Value added ($2013)*
Alternative A			
Direct effects	0	$0	$0
Secondary effects	5	$146,900	$294,400
Total effects	5	$146,900	$294,400
Alternative B			
Direct effects	0	$0	$0
Secondary effects	7	$230,400	$461,800
Total effects	7	$230,400	$461,800
Alternative C			
Direct effects	0	$0	$0
Secondary effects	5	$170,400	$341,500
Total effects	5	$170,400	$341,500
Alternative D			
Direct effects	0	$0	$0
Secondary effects	8	$265,300	$531,800
Total effects	8	$265,300	$531,800

Effects of Refuge Complex Purchases of Goods and Services within the Local Economy

Local purchases of supplies and services for refuge complex operations contribute to the local economic impacts associated with the refuge complex. The refuge complex spends an average of $389,000 per year on non-salary expenditures. Major local expenditures include office supplies, utilities, and supplies related to habitat and grounds improvements. Table 24 provides a breakdown of current non-salary expenditures by expenditure category. To find the local economic impacts of non-salary expenditures, only expenditures made within the local four-county area are included in the analysis. This analysis assumes that the percent of local spending will not differ across the alternatives.

Table 24. Breakdown of current purchases of goods and services.

Expense category	*Average annual percent of non-salary expenditures*	*Percent spent in local four-county area*
Heavy equipment purchasing and leasing	4	64
Equipment maintenance and repair	5	83
Vehicle purchase	7	0
Vehicle maintenance and repair	4	92
Habitat and grounds improvements and treatments (not including acquired lands restoration)	32	93
Travel	1	0
Maintenance and repair of structures	3	100
Environmental and other technical consulting services	1	100
All other expenses	44	2

Average annual non-salary expenditures are expected to be $389,400 for alternative A, $431,000 for alternative B, $398,000 for alternative C, and $496,400 for alternative D. Table 25 shows the economic impacts associated with non-salary expenditures in the local communities near the refuge complex. For alternative A, the purchase of goods and services would generate an estimated total economic impact of 6 jobs, $153,500 in labor income, and $164,900 in value added annually. Under alternative B, 6 jobs, $169,900 in labor income, and $182,500 in value added would be generated annually by the purchase of goods and services by the refuge complex. Alternative C would have a similar annual economic impact as B, annually generating 6 jobs, $157,000 in labor income, and $168,500 in value added. Finally, alternative D would have the greatest annual impact, with 7 jobs, $195,700 in labor income, and $210,200 in value added.

Table 25. Annual impacts of purchases of goods and services.

	Employment (number of full and part-time jobs)	*Labor income ($2013)*	*Value added ($2013)*
Alternative A			
Direct effects	5	$133,800	$127,100
Secondary effects	1	$19,700	$37,800
Total effects	6	$153,500	$164,900
Alternative B			
Direct effects	5	$148,100	$140,700
Secondary effects	1	$21,800	$41,800
Total effects	6	$169,900	$182,500
Alternative C			
Direct effects	5	$136,800	$129,900
Secondary effects	1	$20,200	$38,600
Total effects	5	$170,400	$341,500
Alternative D			
Direct effects	6	$170,600	$162,000
Secondary effects	1	$25,100	$48,200
Total effects	7	$195,700	$210,200

Effects of Visitor Expenditures

Visitor spending generates significant economic activity in areas near refuges. The Service's report "Banking on Nature: The Economic Benefits of National Wildlife Refuge Visitation to Local Communities" estimated the impact of national wildlife refuges on their local economies (Carver and Caudill 2013). According to the report, more than 46.5 million people visited the national wildlife refuges in fiscal year 2011, which generated $2.4 billion of sales in regional economies. Accounting for both the direct and secondary effects, spending by national wildlife refuge visitors generated more than 35,000 jobs and $792.7 million in employment income (Carver and Caudill 2007). Spending on refuge recreation generated approximately $342.9 million in tax revenue at the local, county, State, and Federal levels (Carver and Caudill 2013). The refuge complex offers a wide variety of recreation opportunities, including wildlife observation and photography, interpretation, environmental education, and waterfowl hunting. Big game hunting is not allowed within the boundaries of the Alamosa and Monte Vista Refuges, but would be allowed on all three refuges under alternatives B, C, and D. The refuge complex would allow fishing on Alamosa Refuge under alternative D.

Annual visitation estimates for the refuge complex are based on several sources, including visitors entering the visitor center and office as well as general observations by refuge staff. Annual visitation estimates are on a per-visit basis. Table 26 summarizes estimated visitation by type of visitor activity for alternatives A, B, C, and D.

Under alternative B, the primary focus is a balance of habitat restoration, enhanced public use, and phasing out the current permitted use of bison on the Baca Refuge.

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Visitors gather at the Monte Vista Refuge office during the Monte Vista Crane Festival. Under alternatives B and D, we would seek funding to build a visitor center at the refuge.

Habitat restoration is also a primary focus of alternative C, with an emphasis on promoting natural processes. On the Monte Vista Refuge, small grain production for sandhill cranes would no longer occur. As with alternative B, the current permitted use of bison on the Baca Refuge would be phased out under alternative C. Wildlife-dependent public uses are expected to be enhanced to a limited degree. Big game hunting would be allowed on refuge complex lands to aid in the management of elk herds.

The aim of alternative D is to maximize compatible public use opportunities across the refuge complex. This would include management specifically for waterfowl production and migration at the Monte Vista and Alamosa Refuges, as well as continued small grain production for sandhill cranes at the Monte Vista Refuge. Big game hunting for elk would be allowed on all three refuges, and fishing opportunities would be available at the Alamosa Refuge. (Refer to table 26 for the estimated annual visitation to the refuge complex for all four alternatives.)

Table 26. Estimated annual refuge complex visitation by alternative.

	Total number of visits	*Number of non-local visits*	*Average hours spent on refuge*	*Number of non-local visitor days*[a]
Alternative A				
Fishing	0	0	4	0
Big game hunting	0	0	8	0
Waterfowl and migratory bird hunting	600	480	6	360
Upland game hunting	0	0	8	0
Nonconsumptive uses	4,610	3,227	2	807
Total Visitation	5,210	3,707		1,167
Alternative B				
Fishing	0	0	4	0
Big game hunting	500	75	8	75
Waterfowl and migratory bird hunting	660	528	6	396
Upland game hunting	500	25	8	25
Nonconsumptive uses	5,763	4,034	2	1,008
Total Visitation	7,423	4,662		1,504
Alternative C				
Fishing	0	0	4	0
Big game hunting	500	75	8	75
Waterfowl and migratory bird hunting	660	528	6	396
Upland game hunting	500	25	8	25
Nonconsumptive uses	4,841	3,388	2	847
Total Visitation	6,501	4,016		1,343
Alternative D				
Fishing	500	50	4	25
Big game hunting	500	75	8	75
Waterfowl and migratory bird hunting	720	576	6	432
Upland game hunting	500	25	8	25
Nonconsumptive Uses	6,454	4,518	2	1,129
Total Visitation	8,674	5,244		1,686

[a] One visitor day = 8 hours.

To estimate visitor expenditures, we used average daily visitor spending profiles from the Banking on Nature report (Carver and Caudill 2007) that were derived from the 2006 National Survey of Fishing, Hunting, and Wildlife Associated Recreation (DOI FWS and Department of Commerce U.S. Census Bureau 2011). The National Survey reports trip-related spending of State residents and non-residents for wildlife-associated recreational activities. For each recreation activity, spending is reported in the categories of lodging, food and drink, transportation, and other expenses. Carver and Caudill (2007) calculated the average per person per visitor day expenditures by recreation activity for each Service region. We used the spending profiles for non-residents for the Mountain-Prairie Region 6 (which includes Colorado), and updated the 2006 spending profiles to 2013 dollars using the Consumer Price Index Inflation Calculator. Average daily spending profiles for non-resident visitors to Region 6 for fishing ($129.94 per day), waterfowl and other migratory bird hunting ($78.44 per day), upland game hunting ($181.97 per day), and big game hunting ($220.84 per day) were used to estimate non-local visitor spending for refuge fishing and hunting related activities. The average daily non-resident spending profile for nonconsumptive wildlife recreation (observing, or photographing fish and wildlife) was used for nonconsumptive wildlife viewing activities ($162.93 per day).

Visitor spending profiles are estimated on an average per day (or 8-hour) basis. Because some visitors only spend short amounts of time visiting a refuge, counting each refuge visit as a full visitor day would overestimate the economic impact of refuge complex visitation. To properly account for the amount of spending, the annual number of non-local refuge visits were converted to visitor days. Refuge staff estimate that non-local anglers would spend approximately 4 hours (1/2 a visitor day) on the refuge, while waterfowl and upland game hunters would spend approximately 8 hours (1 visitor day). Non-local visitors that view wildlife on nature trails or take part in other wildlife observation activities typically spend 4 hours (1/2 a visitor day). Table 27 shows the number of non-local visitor days by recreation activity for each alternative. Total spending by non-local refuge visitors was calculated by multiplying the average non-local visitor daily spending by the number of non-local visitor days at the refuge.

Table 27 summarizes the total economic impacts associated with current non-local visitation by alternative. Under alternative A, non-local refuge complex visitors would spend nearly $159,700 in the local economy annually. This spending would directly account for an estimated 1 job, $36,600 in labor income, and $60,700 in value added in the local economy. The secondary or multiplier effects would generate another $9,900 in labor income and $18,300 in value added. Accounting for both the direct and secondary effects, spending by non-local visitors for alternative A would generate total annual economic impacts of 1 job, $46,500 in labor income, and $79,000 in value added.

As shown in table 26, non-local visitation to the refuge complex for all activities is expected to increase by 288 visitor days under alternative B as compared with alternative A. Under alternative B, non-local visitors would spend approximately $216,100 in the local area annually. Accounting for both the direct and secondary effects, spending by non-local visitors for alternative B would generate an estimated total annual economic impact of 1 job, $62,900 in labor income, and $106,800 in value added.

Table 27. Annual impacts of non-local visitor spending by alternative

	Employment (number of full and part-time jobs)	*Labor income ($2013)*	*Value added ($2013)*
Alternative A			
Direct effects	1	$36,600	$60,700
Secondary effects	0	$9,900	$18,300
Total effects	1	$46,500	$79,000
Alternative B			
Direct effects	1	$49,400	$82,200
Secondary effects	0	$13,500	$24,600
Total effects	1	$62,900	$106,800
Alternative C			
Direct effects	1	$43,400	$72,100
Secondary effects	0	$11,800	$21,500
Total effects	1	$55,200	$93,600
Alternative D			
Direct effects	2	$55,200	$91,900
Secondary effects	0	$15,000	$27,600
Total effects	2	$70,200	$119,500

Refuge complex non-local visitation for all activities is expected to increase by 58 visitor days under alternative C as compared with alternative A (table 26). Under alternative C, non-local refuge visitors would spend approximately $189,900 in the local area annually. This spending by non-local visitors for alternative C would generate an estimated total economic impact of 1 job, $55,200 in labor income, and $91,900 in value added.

Refuge complex non-local visitation is expected to increase by 461 visitor days under alternative D as compared with alternative A (table 26). Under alternative D, non-local refuge visitors would spend approximately $241,900 in the local area annually. This spending by non-local visitors would generate an estimated total annual economic impact of 2 jobs, $70,200 in labor income, and $191,500 in value added.

Summary Across All Alternatives

The economic impacts across the alternatives are summarized below.

Summary of Economic Impacts for Alternative A (No-Action Alternative)

Table 28 summarizes the direct and total economic impacts in the four-county area of refuge complex management activities for alternative A. Under alternative A, refuge complex management activities directly related to refuge operations generate an estimated 12 jobs, $321,100 in labor income, and $487,500 in value added in the local economy. Including direct, indirect, and induced effects, all refuge activities generate a total annual economic impact of 13 jobs, $367,600 in labor income, and $566,500 in value added. Total economic effects of refuge complex operations play a much larger role in the communities near the refuge where most of the refuge-related expenditures and public use-related economic activity occurs.

Summary of Economic Impacts for Alternative B

Table 29 summarizes the direct and total economic impacts of refuge management activities for alternative B. Under alternative B, refuge complex management activities would generate an estimated 14 jobs, $421,000 in labor income, and $672,500 in value added in the local economy. Including direct, indirect, and induced effects, all refuge complex activities would generate a total economic impact of 15 jobs, $483,900 in labor income, and $779,300 in value added annually.

Table 28. Annual economic impacts for alternative A.

	Employment (number of full and part-time jobs)	*Labor income ($2013)*	*Value added ($2013)*
Refuge administration[a]			
Direct effects	6	$151,500	$149,600
Total effects	12	$321,100	$487,500
Public use activities			
Direct effects	1	$36,600	$60,700
Total effects	1	$46,500	$79,000
Aggregate impacts			
Direct effects	5	$136,800	$129,900
Total effects	5	$170,400	$341,500

[a] Refuge administration impacts include impacts associated with Refuge Revenue Sharing Act payments made to counties, personnel salary expenditures made in the local four-county area, and refuge non-salary expenditures made in the local four-county area.

Table 29. Annual economic impacts for alternative B.

	Employment (number of full and part-time jobs)	*Labor income ($2013)*	*Value added ($2013)*
Refuge administration[a]			
Direct effects	6	$165,800	$163,200
Total effects	14	$421,000	$672,500
Public use activities			
Direct effects	1	$49,400	$82,200
Total effects	1	$62,900	$106,800
Aggregate impacts			
Direct effects	7	$215,200	$245,400
Total effects	15	$483,900	$779,300

[a] Refuge administration impacts include impacts associated with Refuge Revenue Sharing Act payments made to counties, staff salary expenditures made in the local four-county area, and refuge non-salary expenditures made in the local four-county area.

Table 30 summarizes the change in economic effects associated with refuge complex operations under alternative B as compared to alternative A. Because of the expected increases in refuge staff and refuge complex visitation, alternative B would generate an increased annual economic impact of 2 jobs, $116,300 in labor income, and $212,800 more in value added as compared to alternative A.

Table 30. Change in economic impact from alternative B compared to alternative A.

	Employment (number of full and part-time jobs)	*Labor income ($2013)*	*Value added ($2013)*
Refuge administration[a]			
Direct effects	no change	(+) $14,300	(+) $13,600
Total effects	(+) 2	(+) $99,900	(+) $185,000
Public use activities			
Direct effects	no change	(+) $12,800	(+) $21,500
Total effects	no change	(+) $16,400	(+) $27,800
Aggregate impacts			
Direct effects	no change	(+) $27,100	(+) $35,100
Total effects	(+) 2	(+) $116,300	(+) $212,800

[a] Refuge administration impacts include impacts associated with Refuge Revenue Sharing Act payments made to counties, staff salary expenditures made in the local four-county area, and refuge non-salary expenditures made in the local four-county area.

Summary of Economic Impacts for Alternative C

Table 31 summarizes the direct and total economic impacts of refuge complex management activities for alternative C. Under alternative C, refuge complex management activities directly related to refuge operations would generate an estimated 12 jobs, $348,100 in labor income, and $538,200 in value added in the local economy. Including direct, indirect, and induced effects, all refuge activities would generate a total economic impact of 13 jobs, $403,300 in labor income, and $631,800 in value added annually.

Table 32 summarizes the change in economic effects associated with refuge complex operations under alternative C compared to alternative A. Because of slight increases in refuge visitation and administration, alternative C would generate $35,700 more in labor income and $65,300 more in value added annually compared to alternative A.

Table 31. Annual economic impacts for alternative C.

	Employment (number of full and part-time jobs)	*Labor income ($2013)*	*Value added ($2013)*
Refuge administration[a]			
Direct effects	6	$154,500	$152,400
Total effects	12	$348,100	$538,200
Public use activities			
Direct effects	1	$43,400	$72,100
Total effects	1	$55,200	$93,600
Aggregate impacts			
Direct effects	7	$197,900	$224,500
Total effects	13	$403,300	$631,800

[a] Refuge administration impacts include impacts associated with RRS payments made to counties, staff salary expenditures made in the local four-county area, and refuge non-salary expenditures made in the local four-county area.

Table 32. Change in economic impact from alternative C compared to alternative A.

	Employment (number of full and part-time jobs)	*Labor income ($2013)*	*Value added ($2013)*
Refuge administration[a]			
Direct effects	No change	(+) $3,000	(+) $2,800
Total effects	No change	(+) $27,000	(+) $50,700
Public use activities			
Direct effects	No change	(+) $6,800	(+) $11,400
Total effects	No change	(+) $8,700	(+) $14,600
Aggregate impacts			
Direct effects	No change	(+) $9,800	(+) $14,200
Total effects	No change	(+) $35,700	(+) $65,300

[a] Refuge administration impacts include impacts associated with RRS payments made to counties, staff salary expenditures made in the local four-county area, and refuge non-salary expenditures made in the local four-county area.

Summary of Economic Impacts for Alternative D

Table 33 summarizes the direct and total economic impacts in the four-county area of refuge management activities for alternative D. Under alternative D, refuge complex management activities would generate an estimated 16 jobs, $481,700 in labor income, and $770,200 in value added in the local economy. Including direct, indirect, and induced effects, all refuge complex activities would generate a total economic impact of 18 jobs, $551,900 in labor income, and $889,700 in value added annually.

Table 33. Annual economic impacts for alternative D.

	Employment (number of full and part-time jobs)	Labor income ($2013)	Value added ($2013)
Refuge administration[a]			
Direct effects	7	$188,300	$184,500
Total effects	16	$481,700	$770,200
Public use activities			
Direct effects	2	$55,200	$91,900
Total effects	2	$70,200	$119,500
Aggregate impacts			
Direct effects	9	$243,500	$276,400
Total effects	18	$551,900	$889,700

[a] Refuge administration impacts include impacts associated with Refuge Revenue Sharing Act payments made to counties, staff salary expenditures made in the local four-county area, and refuge non-salary expenditures made in the local four-county area.

Table 34 summarizes the change in economic effects associated with refuge complex operations under alternative D compared to alternative A. Because of significant increases in refuge visitation and administration, alternative D would generate an increased annual economic impact of 5 jobs, $184,300 in labor income, and $323,200 in value added compared to alternative A.

Table 34. Change in economic impact for alternative D compared to alternative A.

	Employment (number of full and part-time jobs)	Labor income ($2013)	Value added ($2013)
Refuge administration[a]			
Direct effects	(+) 1	(+) $36,800	(+) $34,900
Total effects	(+) 4	(+) $160,600	(+) $282,700
Public use activities			
Direct effects	(+) 1	(+) $18,600	(+) $31,200
Total effects	(+) 1	(+) $23,700	(+) $40,500
Aggregate impacts			
Direct effects	(+) 2	(+) $55,400	(+) $66,100
Total effects	(+) 5	(+) $184,300	(+) $323,200

[a] Refuge administration impacts include impacts associated with Refuge Revenue Sharing Act payments made to counties, staff salary expenditures made in the local four-county area, and refuge non-salary expenditures made in the local four-county area.

Summary and Conclusions

Under alternative A, refuge complex management activities annually generate an estimated 13 jobs, $368,500 in labor income, and $568,200 in value added in the local economy.

Given the increases in refuge administration and public use activities, alternative B would annually generate 2 more jobs, $116,300 more in labor income, and $212,800 more in value added annually compared to alternative A.

Under alternative C, refuge complex public use and administration activities would also increase. Alternative C would annually generate $35,600 more in labor income, and $64,900 more in value added compared to alternative A.

Under alternative D, the refuge complex would expect the greatest increase in visitation as well as staff needs. Alternative D would annually generate 5 jobs, $184,300 in labor income, and $323,200 in value added compared to alternative A.

Total economic impacts associated with refuge complex operations across all alternatives represent less than one-tenth of 1 percent of total income and total employment in the overall four-county local economy. The total economic effects of refuge operations play a much larger role in the communities near the refuge complex where most of the refuge-related expenditures and public use-related economic activity occurs.

Environmental Justice

Within the spirit and intent of Executive Order 12898, Federal actions to address environmental justice in minority populations and low-income populations, no actions in this draft CCP and EIS would disproportionately place any adverse environmental, economic, social, or health effects on minority or low-income populations as compared to all of the public.

Under all alternatives, we would not charge for public use activities, and a variety of opportunities and activities would be offered for all visitors and local citizens.

In partnership with other Federal agencies and a number of Native American tribes, we are entering into an agreement for projects that would require compliance with the Native American Graves Protection and Repatriation Act of 1990. The agreement addresses the treatment and disposition of all Native American human remains, associated and unassociated funerary objects, sacred objects, and objects of cultural patrimony which are defined as agency collections or are found as a result of inadvertent discovery or intentional evacuation on our lands.

The refuge complex lies within the Sangre de Cristo National Heritage Area. None of the alternatives would negatively affect the values for which the Heritage Area was established. We would work with the NPS to interpret the Pedro Trujillo Homestead and protect the cultural heritage of the site.

We also recognize that the refuge complex is centrally located to the communities of Alamosa, Monte Vista, and Crestone, and that some of these communities have a proportion of lower income citizens as compared with other areas in the State. Our alternatives recognize that our refuges offer unique options for engaging children and adults who do not have many opportunities to experience nature, and we are committed to working with the schools and local universities to find ways to promote and get more minority and low-income children engaged in environmental education and other activities.

We are committed to ensuring that all members of the public have equal access to America's fish and wildlife resources, as well as equal access that would enable them to meaningfully take part in activities and policy shaping.

Cumulative Impacts on the Socioeconomic Environment

Many of the foreseeable activities described in chapter 3 are expected to help socioeconomic conditions in the San Luis Valley. For example, land development and solar energy development activities are expected to stimulate the local economy; resource management initiatives such as the San Luis Valley regional habitat conservation plan (Rio Grande Water Conservation District 2012b) and ground water management subdistricts are expected to provide a stable and sustainable regulatory environment for agriculture; and the implementation of the Sangre de Cristo National Heritage Area Management Plan is expected to improve heritage tourism opportunities. The socioeconomic benefits that are expected to result from the proposed refuge management alternatives, when combined with these and other foreseeable activities in the region, would result in minor cumulative benefits to the socioeconomic environment over the long term.

5.10 Irreversible and Irretrievable Resource Commitments

NEPA requires a discussion of any irreversible or irretrievable commitments of resources that would result from implementing the alternatives. An irreversible commitment of resources means that nonrenewable resources are permanently lost because of plan implementation. In contrast, an irretrievable commitment of resources is the loss of resources or resource production, or the use of renewable resources during the 15-year implementation period of the plan (or longer).

All the alternatives, including the no-action alternative, would result in some irreversible loss of soil resources. Topsoil would be removed before facility construction (primarily under alternatives B and D) but would be reused in revegetation of disturbed areas. Even with the best management practices, some irreversible soil loss from erosion could occur. Although we would make every effort to fence livestock out of riparian areas, any accidental grazing in these areas, particularly during certain periods, could contribute to soil erosion and further degradation of streambanks. Ineffective dispersal or harvest of elk, particularly under the no-action alternative, would lead to further degradation of streambanks and soil erosion in some locations.

The use of Federal money for staff and operations would be an irretrievable commitment of resources because this money would not be available for other Federal programs or projects.

Any construction would require expenditures of Federal funds for the costs of construction. Money for operations and periodic maintenance in perpetuity would be required, which would commit future generations to these expenditures. An increased commitment of maintenance services because of increased public use or modification of infrastructure would be required.

Aggregate and other materials would be needed for construction of facilities and roads. Gasoline, diesel, and oil used by motor vehicles and other equipment, either by the Service, contractors, or the public, would represent an irreversible commitment of resources because their use is lost for future generations.

Land that was physically altered for restoring natural water flows would be committed to the new use, representing a change in the function and production of existing wetlands on the refuges and a possible change in soil chemistry.

Our efforts to protect and restore riparian habitat could help the southwestern willow flycatcher and other riparian species within the constraints of the hydrology. However, there would be less water for waterfowl and other migratory birds because of droughts, climate change, and funding constraints. During some years, wetlands would be dry, resulting in irretrievable losses of waterfowl production or hunting opportunities.

Removal or disturbance of any unknown cultural resources would result in irretrievable and irreversible loss of resources.

Increased emissions from refuge operations would not exceed Federal or State air quality standards. Air quality would return to existing conditions following prescribed fires and other disturbances that resulted in increased dust or other emissions. Increased visitor access on refuge roads would not affect regional air quality. The Class I air quality areas next to the Baca Refuge would not be affected.

Short-term obstruction or temporary disruption to local roads would occur during construction of a new visitor center at the Monte Vista Refuge. There would be no long-term impacts to local roads.

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Winter on the Baca Refuge

5.11 Short-term Uses of the Environment Versus Maintenance of Long-term Productivity

Historical uses of the refuge, including early settlement, agricultural uses, roads and access, livestock grazing, haying, mowing, and visitor facilities, have affected the long-term productivity of the refuge complex's ecology. Short-term factors associated with implementing the CCP include (1) restoration of former agricultural areas, (2) restoration of riparian areas or water impoundments, (3) construction of facilities or boundary fences, (4) removal of fencing, (5) improving and maintaining roads, and (6) building new or renovating existing facilities to support visitor services.

Implementation of this CCP, including management activities such as prescribed fire, livestock grazing, hunting to control wildlife populations, and the control of invasive species, would contribute to the maintenance and enhancement of long-term productivity of the refuge environment. Restoration of natural flow patterns on the Alamosa and Monte Vista Refuges would result in better management of the refuge complex's water resources. This would be at the expense of existing artificial wetlands that are usually wet annually. There would be both short-term and long-term losses in waterfowl production. Other migratory birds would benefit over the long term as some wetlands returned to uplands.

5.12 Adherence to Planning Goals

The following sections are descriptions of how well each alternative meets each goal for the refuge complex. Table 35 summarizes this discussion.

Table 35. How well the actions meet the goals for the Refuge Complex.

Goal	*Alternatives—adherence to goals**			
	A	*B*	*C*	*D*
Habitat and wildlife management	✕	✓	✓	✦
Water resources	✦	✓	✓	✓
Partnerships and refuge complex operations	✦	✓	✓	✓
Visitor services	✕	✓	✦	✓
Research, science, and wilderness review	✦	✓	✓	✓
Cultural resources and tribal coordination	✕	✓	✦	✓

*Ratings note that an alternative satisfies the goal (✓), partially satisfies the goal (✧), or does not satisfy the goal (✕).

Habitat and Wildlife Management

The goal is to *conserve, restore, and improve the biological integrity, environmental health, and ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.* (Refer to chapter 2.) The three national wildlife refuges are important stopovers for many migratory birds, including nesting, migrating, and wintering bird species.

Under alternative A (the no-action alternative), the Rio Grande corridor and its tributaries on the Alamosa Refuge would be protected and managed to provide habitat for riverine, riparian-dependent, and other species. Little would be done to enhance willow habitat for the southwestern willow flycatcher along the Rio Grande, except what could be accomplished with our existing funding and staff resources. On the Baca Refuge, obvious signs of degradation of the five creek corridors would be addressed within existing resource levels. Outside of the actions identified in the interim elk management plan (FWS 2013e), which includes dispersal hunts on the Baca Refuge in the areas formerly owned by the State, few other tools would be available for addressing ongoing elk management concerns within the refuge complex.

Under alternative A and to some extent under alternative D, our existing water management strategy would continue to provide wetland habitat for migrating sandhill cranes and waterfowl. However, our current analysis of the condition of our wetland habitats has shown that our water management regime cannot sustain the integrity, productivity, and function of many of the wetland habitats, given the recent dynamic climatic variations and the continual battle with invasive species. Anticipated changes in State water law (ground water rules and regulations) would affect the future volume and timing of available water on the refuge. Many wetland habitats would not be able to support the migrating and nesting populations of wildlife species that they have in the past. For this reason, it only partially satisfies the goal.

Because the water for playa habitats on the Baca Refuge is from creeks originating in the Sangre de Cristo Mountains, water availability is largely dependent on the timing, duration, and volume of spring snowmelt. Under existing conditions, peak runoff does not coincide with spring shorebird migration. Under alternatives B and D, water would be adaptively rotated to provide water to the playas at a minimum of once out of 3 years. For alternative C, by directing water into the lowest elevation flowpaths in each creek, water would likely enter the playas sooner in the spring. Water would continue to enter the playa habitat throughout the snowmelt runoff period.

Under alternatives B, C, and D, besides protecting and managing existing habitat along the Rio Grande corridor, specific objectives would be established for restoring many of the 21 miles of four creek drainages on the Baca Refuge. On average, a variety of tools would be used to achieve a greater than 35 percent canopy cover about 15 to 30 feet wide, in addition to implementing public hunting for big game (primarily elk) . This would help to disperse elk out of riparian areas). We would reduce browsing pressure by installing elk-proof fencing, dispersing elk out of riparian habitats, and using agency culling and public hunting. Supplemental planting of willows and cottonwoods would be used along the reaches where natural regeneration is low.

With the lack of staff resources and stated objectives for restoration or elk management, alternative A would not meet the stated goals for restoring and improving biological integrity, environmental health, and habitat diversity across the refuge complex.

Alternative D would partially meet these goals. Riparian areas would be improved on the Baca Refuge, but it would be more difficult to achieve these objectives, particularly on the Alamosa Refuge, given that the overall water management strategy would not change to any significant degree. This alternative would require the most investment in providing for public uses, and fewer resources could be used for habitat improvements.

Alternatives B and C would meet the stated goal for riparian, wetland, and playa habitats. Although alternative C would be the best for restoring the long-term biological health and ecological function of the refuge complex, there would fewer wetlands and subsequently fewer waterfowl and other waterbirds that could be supported. Alternative B would balance restoration of ecological function with achieving a variety of wetland conditions to support a diversity of migratory birds.

Water Resources

The goal is to *protect, acquire and manage surface and ground water resources to maintain and support management objectives.* Under all the alternatives, we would keep our water rights and use them to maximize wildlife habitat. Although water resources would be used differently under each action alternative, all alternatives would satisfy this goal.

Visitor Services

The goal is to *provide safe, accessible, and quality wildlife-dependent recreation and perform outreach to visitors and local communities to nurture an appreciation and understanding of the unique natural and cultural resources of the refuge complex and San Luis Valley.*

Safety would be emphasized under every alternative.

Alternative A would not satisfy the outreach part of this goal because of the lack of dedicated resources for providing visitor services and the few opportunities for most visitors to experience much of the refuge complex. Alternative D would provide the greatest opportunities for wildlife-dependent recreation. Alternatives B and D satisfy the goal because they would provide for the most opportunities, facilities, programming, outreach, and staff to nurture an appreciation and understanding of the unique natural and cultural resources of the refuge complex. Alternative C would partially satisfy the goal by opening the Baca Refuge to public hunting and by adding more staff for visitor services.

Alternative D would provide for the greatest amount of accessible facilities, followed by alternative B. Alternative C would provide for the least amount of accessible facilities.

Partnerships and Refuge Complex Operations

The goal is to *secure and effectively use funding, staffing, and partnerships for the benefit of all resources in support of the refuge complex purposes and the mission of the Refuge System.* A second part of the goal is to *actively pursue and continue to foster partnerships with other agencies, organizations, the water community, and private landowners to conserve, manage, and provide long-term sustainability of the working landscapes within the San Luis Valley ecosystem.*

Under all the alternatives, we would keep our current partnerships. Although the 2003 CCP did not have a specific goal for partnerships, we work closely with many tribes; Federal, State, and local agencies; and other organizations, and that would not change. Given the limited staff and funding, there would be limited opportunities to actively pursue and establish new partnerships for habitat and wildlife management or public uses. Subsequently, alternative A would only partially meet this goal. Although the action alternatives vary in emphasis, under all alternatives we would seek to increase partnerships to achieve our habitat, wildlife, and public use objectives. We would also seek more staff funding to achieve our goals. Therefore, alternatives B, C, and D would satisfy this goal.

Cultural Resources and Tribal Coordination

The goal is to *protect significant cultural resources within the refuge complex.*

Under all alternatives, we would continue to adhere to cultural resource laws and avoid adverse effects on significant resources.

Under the existing CCP (FWS 2003) and the 2005 conceptual management plan for the Baca Refuge (FWS 2005), protection of cultural resources was not a specific goal. With the existing staff resources, it is difficult to increase protection, monitoring, outreach, interpretation, or partnerships beyond basic adherence to cultural resource laws and the enthusiasm of the Service's cultural resource staff. Therefore, alternative A does not satisfy the goal or it does so only minimally.

In part because of increased staff levels, the action alternatives would enable the staff to better protect significant resources and increase our outreach and partnership levels. Alternatives B and D would result in the best protection of cultural resources because of increased educational outreach and partnership efforts to increase awareness and support for cultural resources. Under these alternatives, there would be better understanding of cultural resources, increased law enforcement of sites, and better protection of significant structures. Implementation of either of these alternatives would lead to more survey work, recording of important sites, and incorporation of cultural resources in our interpretive themes and messages. Alternative D would go further than alternative B in education and outreach efforts in meeting the goal.

Alternative C would be similar to alternative A. Insignificant structures that are not needed for refuge operations may be removed, but new cultural resource priorities would be established, so it would partially satisfy the goal.

Research, Science, and Wilderness Review

The goal is to *use sound science, applied research, monitoring, and evaluation to advance the understanding of natural resource functions, the changing climate conditions, wilderness values, and management of the habitats within the San Luis Valley ecosystem.*

In the 2003 CCP, these topics were not addressed. Although we would be required under any alternative to implement the Service's policies regarding climate change, under alternative A, there are not the staff resources to do much toward advancing our understanding of natural resource functions, changing climate conditions, and habitat management. Wilderness values would not be protected. Therefore, alternative A would not satisfy this goal. Although alternatives B, C, and D have varying management emphases, with increased staff, outreach, and protection of wilderness values on the Baca Refuge, alternatives B, C, and D would satisfy the goal.

5.13 Unavoidable Adverse Effects

Most adverse or negative environmental effects associated with implementation of the CCP would be short term and minimal, but some long-term negative or adverse effects could occur.

During construction of visitor facilities on the refuge complex under alternatives B and D, wildlife would be disturbed and temporarily displaced. This construction would also result in minor, short-term disturbance of soils; and subsequent erosion could lead to a spread of invasive species if control measures are not put in place. The removal or modification of infrastructure such as dikes would result in minor, short-term disturbance of soils and erosion, resulting in minor to moderate long-term changes to vegetation and soil chemistry

The use of prescribed fire would result in short-term losses of vegetation. There is always the potential for prescribed fire to escape the refuge boundary and burn onto private lands, resulting in unavoidable adverse effects. By following prescribed fire plans, maintaining fire breaks, preventing wildland fires, and using approved fire prescriptions, the risk of prescribed fires escaping the established parameters would be greatly reduced.

Overall, implementation of the CCP under alternatives B, C, or D would result in minor to moderate long-term benefits for the biological community and the diversity and productivity of the refuge complex ecosystem. Restoring former agricultural fields on the Monte Vista Refuge would increase the amount of native vegetation. However, under alternative C, eliminating grain production and restoring these fields would have a moderate to major long-term adverse effect on sandhill cranes on the refuge and a minor effect on cranes in the San Luis Valley. Elk hunting on the refuge complex would result in some short-term adverse effects on individual elk but would result in minor to moderate long-term benefits for the overall population by increasing the stability and sustainability of the population.

On the Monte Vista and Alamosa Refuges, by gradually managing water resources to take advantage of natural flowpaths and depressions, we could focus limited water resources to the most productive wildlife areas and increase water in the deeper channels. However, in some areas of the refuge complex, there could be less waterfowl productivity in the long term. The implementation of alternative C would result in minor long-term negative effects on wetland-dependent bird species on the Alamosa and Monte Vista Refuges.

The use of prescribed fire on the refuge complex could adversely impact some individual grassland birds. Burns during the nesting season would be the most detrimental to birds and small mammals, depending on the uniformity and severity of a burn and the ability of the bird to re-nest. There would not be significant increases in the use of prescribed fire under any action alternative. Careful consideration of the timing of fires would limit adverse effects on bird species.

Under all alternatives, limiting visitor access during the nesting season would continue to benefit wildlife. Allowing for a moderate increase in compatible wildlife-dependent uses, particularly under alternatives B and D, could negatively affect some individuals. Negative impacts for the endangered southwestern willow flycatcher would be limited by restricting visitors to on-trail use along the Rio Grande walking trail and any trails near riparian areas. Similarly, the action alternatives are expected to result in beneficial or neutral effects for threatened and endangered species and species of concern. Keeping livestock out of riparian areas would limit adverse effects on riparian vegetation and associated wildlife species.

While most of the actions identified for cultural resources would largely be beneficial, some unavoidable adverse effects could occur. For example, some insignificant structures would be removed or could be allowed to fade away through benign neglect under the action alternatives. Under all alternatives, adverse effects on historic properties (resources eligible for the National Register of Historic Places) would be avoided whenever possible. In cases where an adverse effect to a historic property is unavoidable, consultation under Section 106 of the National Historic Preservation Act would be conducted to resolve the adverse effect. Under alternative C, the greatest number of structures would be removed because the focus of management would be on restoring natural processes. In spite of increased monitoring, more survey work, and greater law enforcement presence, some significant structures could be vandalized as a result of increased access resulting in an unavoidable adverse effect. Lack of money could limit our ability to establish active erosion control measures on threatened sites, which would result in unavoidable adverse effects.

5.14 Conflicts with Federal, Tribal, State, and Local Agencies

Generally, the actions considered in this EIS do not appear to specifically conflict with the missions, goals, or other management plans of the BLM, BOR, USFS, NPS, NRCS, CPW, or Colorado Water Resources Division.

BOR has the authority to operate, maintain, and monitor the infrastructure related to the Closed Basin Project on the Baca and Alamosa Refuges; none of the actions described in this CCP and EIS would directly or indirectly interfere with this operation. Our mission (wildlife conservation) is quite different from those of BOR and the Rio Grande Water Conservation District (political subdivision); the primary mission of the water conservation district is ground water removal under the Baca Refuge and total water management in the San Luis Valley with respect to the Rio Grande Compact requirements so there is always the potential for conflict. We regularly attend meetings with the water conservation district and others on water management issues.

We work with the NPS and TNC in carrying out the goals of the Colorado Greater Sand Dunes interagency fire management plan and our participation would continue. We also work closely with other Federal agencies on issues of mutual concern, and we are a cooperating agency on the NPS's ungulate management planning effort. NPS has been closely involved with us in the development of this plan.

We work closely with CPW on a range of issues related to hunting management and fish management. The State is responsible for mitigating wildlife impacts on neighboring private lands. The State shares many of the same concerns that we have regarding management of the growing elk population on all the refuges, and they support having a public hunt on the refuges.

With our other Federal agency partners, we are in the process of finalizing a Memorandum of Understanding with many tribes that have ties to the San Luis Valley for projects that require compliance with the Native American Graves Protection and Repatriation Act. The agreement creates a process for notification to the tribes and reburial of repatriated remains and sacred objects. The agencies agree to hold periodic government-to-government consultation meetings to address the issues related to the agreement. (Refer to chapter 4, section 4.6.) Frequent communication with the tribes would reduce the potential for conflicts.

5.15 Comparison of Environmental Consequences

Table 37 summarizes the above environmental consequences, by estimated level of benefit or impact, to compare refuge management under each alternative.

Table 37. Summary of environmental consequences for the CCP and EIS for San Luis Valley refuges.

Alternative A—No-Action	*Alternative B—Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Draft Proposed Action)*	*Alternative C—Habitat Restoration and Ecological Processes*	*Alternative D—Maximize Public Use Opportunities*
Climate Change			
Continuing to protect vegetation and reducing energy consumption would be beneficial; vehicle emissions from refuge management activities or visitor use would result in negligible effects on climate change	Same as A	Same as A	Same as A
Negligible overall effect on global climate change	Same as A	Same as A	Same as A
Air Quality			
Motorized Equipment Use			
Negligible effect	Same as A.	Same as A.	Same as A.
Prescribed Fire			
Short-term negligible impacts from 2 or 3 prescribed fires annually	Same as A	Same as A	Same as A
Motorized Vehicles			
Dust, carbon monoxide, and hydrocarbon emissions; negligible effect	Same as A plus increased emissions for short periods of time due to visitor use and refuge operations; negligible effect	Same as A	Same as B
Visual Resources and Night Skies			
Vegetation			
Negligible localized impacts from invasive species	Same as A, plus minor to moderate benefits from riparian habitat restoration	Same as A.	Same as B.
Prescribed Fire			
Short-term negligible impacts	Same as A	Same as A	Same as A
Livestock Grazing			
Short-term, negligible localized impacts	Same as A	Same as A	Same as A
Facilities and Structures			
Negligible overall impact	Same as A	Same as A	Same as A
Soundscapes			
Motorized Vehicles or Equipment			
Negligible impact	Additional traffic from visitor use, with negligible impact	Same as A	Same as B
Hunting			
Negligible impact from gunshots	Same as A	Same as A	Same as A

Table 37. Summary of environmental consequences for the CCP and EIS for San Luis Valley refuges.

Alternative A—No-Action	*Alternative B—Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Draft Proposed Action)*	*Alternative C—Habitat Restoration and Ecological Processes*	*Alternative D—Maximize Public Use Opportunities*
Soils			
Restoration and Infrastructure Management			
Negligible short-term impacts and long-term benefits from soil disturbing activities	Negligible to minor short-term localized impacts and long-term benefits	Minor to major short-term localized impacts and long-term benefits	Same as B
Livestock Grazing, Mowing, and Haying			
Negligible short-term impacts and long-term benefits	Same as A	Same as A	Same as A
Prescribed Fire			
Negligible to minor short-term impacts and long-term benefits	Same as A	Same as A	Same as A
Visitor Services Facilities			
Negligible effect	Negligible to moderate localized soil disturbance along new trails or roads	Same as A	Same as B
Cultural Resource Management			
Negligible impacts to localized areas from research excavations	Same as A	Same as A	Same as A
Water Resources			
Water Quantity and Quality			
Negligible effect	Negligible to minor benefit from water quality monitoring; managing water resources more efficiently; restoring natural flow patterns; and wetland surveys	Similar to B but more restoration of natural water flow patterns	Same as B
Habitat Management			
Negligible effect	Negligible to minor benefits from riparian habitat restoration	Minor benefits from riparian habitat restoration	Negligible to minor benefits from riparian habitat restoration
Public Use Activities			
Negligible effect	Negligible to minor impacts from waste associated with public use activities	Same as A	Minor to moderate impacts from waste associated with public use activities
Vegetation			
Riparian Habitat			
Negligible long-term benefits from habitat management	Moderate long-term benefits due to habitat enhancement efforts	Negligible long-term benefits from habitat management	Moderate long-term benefits due to habitat enhancement efforts

Table 37. Summary of environmental consequences for the CCP and EIS for San Luis Valley refuges.

Alternative A—No-Action	*Alternative B—Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Draft Proposed Action)*	*Alternative C—Habitat Restoration and Ecological Processes*	*Alternative D—Maximize Public Use Opportunities*
Negligible impacts from visitor use	Minor, long term localized impacts from increased visitor use and facilities	Negligible impact from visitor use	Minor to moderate, long-term localized impacts from increased visitor use and facilities
Wetland Habitat			
Minor long-term benefits from habitat management	Moderate long-term benefits due to wetland management efforts.	Minor, short-term impacts from the removal of created wetlands	Same as B
Negligible impacts from visitor use	Minor to moderate long term localized impacts from increased visitor use and facilities	Negligible impacts from visitor use	Same as B
Playa Habitat			
Negligible effect	Minor to moderate long-term benefits from water delivery and playa enhancement efforts	Moderate to major long-term benefits from water delivery/ playa enhancement efforts	Same as B
Upland Habitat			
Negligible long-term benefits from continuation of existing management	Minor long-term benefits from habitat management measures	Same as B	Same as A
Negligible impact from public use activities	Minor long-term impacts from increased visitor use and facilities	Negligible impact from public use activities	Minor to moderate long-term impacts from increased visitor use and facilities
Wildlife: Threatened and Endangered Species and Species of Concern:			
Southwestern willow flycatcher			
Minor, long-term benefits from habitat enhancement efforts; Negligible impacts by allowing trail access along the Rio Grande nature trail on Alamosa Refuge (birds are currently observed along trail near visitor center and auto tour route).	Same as A for habitat enhancement measures; With mitigation measures in place to limit potential visitor impacts, there would be minor impacts from increased trail use along Rio Grande nature trail on Alamosa Refuge and from opening roads and trails within the existing hunt boundary from July 15 to February 28 including portions that traverse the Rio Grande and extending the Bluff nature trail to the south and north along the Rio Grande.	Same as A for habitat enhancement measures; Similar to alternative B for visitor impact except the Bluff nature trail would not be extended south along the Rio Grande. With mitigation measures in place to limit impacts to southwestern willow flycatchers, visitor impacts would be negligible to minor.	Same as A for habitat enhancement measures; In addition to visitor access allowed under alternative B, the Bluff nature trail would be extended south to parking area 5 and made available as a seasonal auto tour route. Fishing access would be allowed at two locations. With mitigation measures put in place, increased visitor use and access would result in moderate impacts.

Table 37. Summary of environmental consequences for the CCP and EIS for San Luis Valley refuges.

Alternative A—No-Action	*Alternative B—Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Draft Proposed Action)*	*Alternative C—Habitat Restoration and Ecological Processes*	*Alternative D—Maximize Public Use Opportunities*
Sandhill crane			
Minor long-term benefits for cranes by providing grains	Same as A with small reduction in amount of grains provided	Moderate to major long-term impact due to the removal of fields used to grow small grains	Moderate long-term benefits from expanded small grain production
Bison			
Bison management phased out; No effect	Implementation of these actions would allow us to better understand the benefits and drawbacks of bison on the landscape. Minor long-term benefit to bison as a focal species, because it would allow us to integrate the species into the landscape.	Negligible benefits for bison as a focal species as a result of limited use of bison as a management tool	Minor long-term benefits from maintaining a small demonstration herd
Elk			
Negligible long-term benefits from population management efforts	Minor long-term benefits from population and disease management efforts	Same as A	Same as B
Native fish			
Negligible long-term benefits	Minor long-term benefits from riparian and aquatic habitat enhancement efforts	Moderate long-term benefits from more extensive habitat enhancement efforts	Same as B
Birds			
Negligible long-term benefits from habitat management	Minor long-term benefits from habitat management	Minor long-term impacts from the removal of created wetlands	Same as B
Negligible localized impacts from increased public access	Minor to moderate localized impacts from visitor increased public access	Same as A	Moderate localized impacts from increased public access
Other Wildlife			
Negligible long-term benefits from habitat management	Minor long-term benefits from habitat management	Same as A	Same as B
Negligible localized impacts from visitor use	Minor localized impacts from visitor use	Same as A	Same as B

Table 37. Summary of environmental consequences for the CCP and EIS for San Luis Valley refuges.

Alternative A—No-Action	*Alternative B—Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Draft Proposed Action)*	*Alternative C—Habitat Restoration and Ecological Processes*	*Alternative D—Maximize Public Use Opportunities*
Visitor Services			
Hunting			
Negligible to minor short-term impacts to waterfowl hunting due to limited water availability and reduced hunting participation; minor to moderate long-term impacts due to continued reduction in available water to support waterfowl	Same as A for waterfowl: minor to moderate long-term impacts hunting; Minor to moderate long-term benefits to small and big game hunting opportunities	Same as A for waterfowl hunting: moderate long-term impacts due to limited water availability. Minor benefits for hunters for small and big game hunting opportunities	Same as A for waterfowl hunting. Moderate benefits for small and big game hunting opportunities in the long term
Fishing			
Negligible effect	Same as A	Same as A	Negligible to minor benefits from expanded walk-in access and seasonal auto tour route on the Alamosa Refuge
Wildlife Observation and Photography			
Negligible effect due to limited opportunities and staffing	Moderate to major long-term benefits from expanded trail and road access and interpretive facilities	Minor long-term benefits from opening trails on Alamosa and Monte Vista Refuges but major impacts for wildlife viewing on the Monte Vista Refuge; negligible benefits on the Baca Refuge due to limited access and facilities. Overall minor to moderate negative impacts.	Same as B
Environmental Education			
Negligible effect because very little environmental education would be offered	Minor to moderate benefits from funding an Outdoor Recreation Planner	Minor benefits from funding but less focus than under alternative B	Moderate to major benefits from funding an Outdoor Recreation Planner
Outreach			
Negligible effect	Moderate benefit resulting from greater outreach efforts	Minor benefits from increased outreach over alternative A	Moderate to major benefits with increased emphasis on outreach
Commercial Recreation			
Negligible effect: Current level of permits (11) would remain	Negligible benefits due to efforts to minimize conflicts	Minor benefits due to additional permits and efforts to reduce conflicts	Same as B
Special Management Areas			
Wilderness			
Negligible impact	Minor to moderate long-term benefits for protecting wilderness values and characteristics	Same as B	Same as B

Table 37. Summary of environmental consequences for the CCP and EIS for San Luis Valley refuges.

Alternative A—No-Action	*Alternative B—Wildlife Populations, Strategic Habitat Restoration, and Enhanced Public Uses (Draft Proposed Action)*	*Alternative C—Habitat Restoration and Ecological Processes*	*Alternative D—Maximize Public Use Opportunities*
Other Special Designations			
No effect	Same as A.	Same as A	Same as A
Cultural Resources			
Cultural Resources: Negligible effect	Negligible to minor benefits due to increased planning, resource protection, and law enforcement	Same as B	Same as B
Socioeconomics			
Regional Economic Impacts			
Negligible effect. Total economic impact is 13 jobs, $367,600 in labor income, and $566,500 in value added.	Negligible benefits. Would generate an additional $116,300 in labor income, $212,800 in value added, and 2 jobs as compared to alternative A	Negligible effect or benefits with $35,700 more in labor income and $65,300 more in value added as compared to alternative A	Negligible to minor benefits with $184,300 more in labor income, $323,200 in value added, and 5 new jobs as compared to alternative A
Environmental Justice			
No effect	Negligible benefits	Same as B	Same as B

Glossary

accessible—Pertaining to physical access to areas and activities for people of different (abilities, especially those) with physical impairments.

active management—The direct manipulation of habitats or wildlife populations to achieve specific objectives. Actions could include planting food plots, managing water levels, prescribed grazing or fire, or wildlife relocations.

adaptive resource management—The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and change management activities; a process that uses feedback from research, monitoring, and evaluation of management actions to support or change objectives and strategies at all planning levels; a process in which policy decisions are carried out within a framework of scientifically driven experiments to test predictions and assumptions inherent in management plan. Analysis of results helps managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.

Administration Act—National Wildlife Refuge System Administration Act of 1966.

alternative—A reasonable way to solve an identified problem or satisfy the stated need (40 CFR 1500.2); one of several different means of accomplishing refuge purposes and goals and contributing to the Refuge System mission (The "Fish and Wildlife Service Manual," 602 FW 1.5).

amphibian—A class of cold-blooded vertebrates including frogs, toads, or salamanders.

annual—A plant that flowers and dies within 1 year of germination.

appropriate use—A proposed or existing uses on national wildlife refuges that meet at least one of the following—(1) is a wildlife-dependent recreational use; (2) contributes to fulfilling refuge purposes, the Refuge System mission, or goals and objectives outline in a CCP; or (3) the refuge manager has evaluated the use and found it to be appropriate.

ATV—All-terrain vehicle.

AUM—Animal-unit month.

baseline—A set of critical observations, data, or information used for comparison or a control.

BCR—Bird conservation region.

biological control—The use of organisms or viruses to control invasive plants or other pests.

biological diversity, also biodiversity—The variety of life and its processes including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur (The "Fish and Wildlife Service Manual," 052 FW 1.12B). The National Wildlife Refuge System's focus is on indigenous species, biotic communities, and ecological processes.

biological integrity—Biotic composition, structure, and function at genetic, organism, and community levels.

biotic—Pertaining to life or living organisms; caused, produced by, or comprising living organisms.

BLM—See Bureau of Land Management.

Bureau of Land Management (BLM)—A Federal agency under the Department of Interior that was established in 1946 through consolidation of the General Land Office and U.S. Grazing Service. The agency has a multiple-use mandate is responsible for a variety of programs for managing and conserving surface and subsurface mineral estates, mostly in the western United States.

Bureau of Reclamation (BOR)—A Federal agency under the Department of Interior that oversees dams, power plants, and canals. The agency oversees the Closed Basin Project in the San Luis Valley which was built to fulfil water obligation delivery downstream of Colorado.

canopy—A layer of foliage, generally the uppermost layer, in a vegetative stand; midlevel or understory vegetation in multilayered stands. Canopy closure (also canopy cover) is an estimate of the amount of overhead vegetative cover.

CCP—See comprehensive conservation plan.

CFR—See Code of Federal Regulations.

cervid—All members of the family Cervidae and hybrids including deer, elk, moose, caribous, reindeer, and related species.

CFR—See Code of Federal Regulations.

cfs—Cubic feet per second.

CO_2—Carbon dioxide.

Code of Federal Regulations (CFR)—The codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government. Each volume of the CFR is updated once each calendar year.

Colorado Division of Water Resources (DWR)—State of Colorado agency charged with management of the State's water resources including administering water rights and issuing water well permits. Also known as the Office of the State Engineer.

Colorado Division of Wildlife (CDOW)—See Colorado Parks and Wildlife.

Colorado Parks and Wildlife (CPW)—State of Colorado wildlife agency; formerly Colorado Division of Wildlife (CDOW)

compatibility determination—See compatible use.

compatible use—A wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the Director of the U.S. Fish and Wildlife Service, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge (The "Fish and Wildlife Service Manual" 603 FW 3.6). A compatibility determination supports the selection of compatible uses and identified stipulations or limits necessary to ensure compatibility.

comprehensive conservation plan (CCP)—A document that describes the desired future conditions of the refuge and provides long-range guidance and management direction for the refuge manager to accomplish the purposes of the refuge, contribute to the mission of the Refuge System, and to meet other relevant mandates (The "Fish and Wildlife Service Manual," 602 FW 1.5).

concern—See issue.

conservation district—Organized in the 1930s as a response to the severe erosion problems, a district is often a political subdivision of a State. Money comes from assessments levied on real property within the boundaries of the district. It helps citizens in conserving renewable natural resources.

cool-season grasses—Grasses that begin growth earlier in the season and often become dormant in the summer. These grasses will germinate at lower temperatures. Examples of cool-season grasses at the refuge are western wheatgrass, needle and thread, and green needlegrass.

county road—In general, means any public highway opened, established, constructed, maintained, abandoned in accordance with State law.

cover, cover type, canopy cover—Present vegetation.

cultural resources—The remains of sites, structures, or objects used by people in the past.

depredation—Destruction or consumption of eggs, broods, or individual wildlife due to a predatory animal; damage inflicted on agricultural crops or ornamental plants by wildlife.

dispersal hunting—A limited public hunt used primarily to control elk numbers and their distribution

DOI—Department of the Interior.

drawdown—The act of manipulating water levels in an impoundment to allow for the natural drying-out cycle of a wetland.

EA—See environmental assessment.

ecological resilience—The ability to absorb disturbances, to be changed, and then to reorganize and still have the same identity, that is, keep the same basic structure and ways of functioning. A resilient system is forgiving of external shocks; a disturbance is unlikely to affect the whole. A resilient habitat (1) sustains many species of plants and animals and a highly variable structural composition; (2) is asymmetric; (3) exemplifies biological integrity, biological diversity, and environmental health; and (4) adapts to climate change.

ecosystem—A dynamic and interrelating complex of plant and animal communities and their associated nonliving environment; a biological community, together with its environment, functioning as a unit. For administrative purposes, the Service has designated 53 ecosystems covering the United States and its possessions. These ecosystems generally correspond with watershed boundaries and their sizes and ecological complexity vary.

ecosystem resilience—See ecological resilience.

EIS—Environmental impact statement.

endangered species, Federal—A plant or animal species listed under the Endangered Species Act of 1973, as amended, that is in danger of extinction throughout all or a significant part of its range.

endangered species, State—A plant or animal species in danger of becoming extinct or extirpated in a particular State within the near future if factors contributing to its decline continue. Populations of these species are at critically low levels or their habitats have been degraded or depleted to a significant degree.

endemic species—Plants or animals that occur naturally in a certain region and whose distribution is relatively limited to a particular locality.

environmental assessment—A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action and alternatives to such action, and provides sufficient evidence and analysis of effects to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

environmental health—Composition, structure, and functioning of soil, water, air, and other abiotic features.

EPA—Environmental Protection Agency.

ephemeral—Lasting for a very short time; short-lived; transitory;

extinction—The complete disappearance of a species from the earth; no longer existing.

extirpation—The extinction of a population; complete eradication of a species within a specified area.

fauna—All the vertebrate and invertebrate animals of an area.

Federal trust resource—A trust is something managed by one entity for another who holds the ownership. The Service holds in trust many natural resources for the people of the United States as a result of Federal acts and treaties. Examples are species listed under the Endangered Species Act, migratory birds protected by international treaties, and native plant or wildlife species found on a national wildlife refuge.

Federal trust species—All species where the Federal Government has primary jurisdiction including federally endangered or threatened species, migratory birds, anadromous fish, and certain marine mammals.

fire management plan (FMP)—A plan that identifies and integrates all wildland fire management and related activities within the context of approved land and resource management plans. The plan defines a program to manage wildland fires (wildfire and prescribed fire).

focal species—A multispecies approach where the ecological needs of a suite of species are used to define an ideal landscape to maintain the range of habitat conditions and ecological processes required by landbirds or other species. Focal species are considered most sensitive to or limited by certain ecological processes (such as fire or nest predation) or habitat attributes (such as patch size). The needs of a suite of focal species are then used to help guide management activities.

forb—A broad-leaved, herbaceous plant; a seed-producing annual, biennial, or perennial plant that does not develop persistent woody tissue but dies down at the end of the growing season.

fragmentation—The alteration of a large block of habitat that creates isolated patches of the original habitat that are interspersed with a variety of other habitat types; the process of reducing the size and connectivity of habitat patches, making movement of individuals or genetic information between parcels difficult or impossible.

Friends group—Any formal organization whose mission is to support the goals and purposes of its associated refuge and the National Wildlife Refuge Association overall; Friends organizations and cooperative and interpretive associations.

FTE—A full-time equivalent; one or more job positions with tours of duty that, when combined, equate to one person employed for the standard Government work-year.

FWS—See U.S. Fish and Wildlife Service.

geocaching—A high-technology scavenger hunt in which objects are hidden at secret outdoor locations for participants to find using Global Positioning System positions posted on the Internet.

geographic information system (GIS)—A computer system capable of storing and manipulating spatial data; a set of computer hardware and software for analyzing and displaying spatially referenced features (such as points, lines and polygons) with nongeographic attributes such as species and age.

GIS—See geographic information system.

Global Positioning System (GPS)—A navigational system involving satellites that allows a user with a receiver to determine precise coordinates for their location on the earth's surface.

goal—Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (The "Fish and Wildlife Service Manual," 620 FW 1.5).

GPS—See Global Positioning System.

GS—General Schedule (pay rate schedule for certain Federal positions).

graminoids—of or relating to grasses.

habitat—Suite of existing environmental conditions required by an organism for survival and reproduction; the place where an organism typically lives and grows.

habitat disturbance—Significant alteration of habitat structure or composition; may be natural (for example, wildfire) or human-caused events (for example, timber harvest and disking).

habitat management plan (HMP)—A stepdown plan to a comprehensive conservation plan that identifies in detail how the objectives and strategies for uplands, riparian areas, river bottoms, and shorelines will be carried out.

habitat type, also vegetation type, cover type—A land classification system based on the concept of distinct plant associations.

HDP—See height density plot.

herbivory—Grazing of grass and other plants by any animal.

heterogeneity—diversity or dissimilar species within a landscape

HMP—See habitat management plan.

HUA—Hydrologic unit area.

huntable—A species that can be hunted on the refuge in accordance with Federal and State regulations.

Hydrogeomorphic methodology evaluation (HGM)—An evaluation of ecosystem restoration and management options. The study evaluates historical and current information about geology, geomorphology, soils, topography, hydrology, plant and animal communities, and other factors for designing future restoration or management approaches.

IMPLAN—Impact Analysis for Planning.

impoundment—A body of water created by collection and confinement within a series of levees or dikes, creating separate management units although not always independent of one another.

Improvement Act—National Wildlife Refuge System Improvement Act of 1997.

indigenous—Originating or occurring naturally in a particular place.

inholding—Non-Service land owned by private, other agency, or other group landowners that is within the boundary of a national wildlife refuge.

integrated pest management—Methods of managing undesirable species such as invasive plants; education, prevention, physical or mechanical methods of control, biological control, responsible chemical use, and cultural methods.

introduced species—A species present in an area due to intentional or unintentional escape, release, dissemination, or placement into an ecosystem as a result of human activity.

invasive plant, also noxious weed—A species that is nonnative to the ecosystem under consideration and whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health.

invertebrates—An animal that lacks an internal skeleton or backbone such as insects, butterflies, and aquatic species like snails.

inviolate sanctuary—A place of refuge or protection where animals and birds may not be hunted.

issue—Any unsettled matter that requires a management decision; for example, a Service initiative, opportunity, resource management problem, a threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition (The "Fish and Wildlife Service Manual," 602 FW 1.5).

lentic—Still-water wetlands. These wetlands occur in basins and lack a defined channel and floodplain. Examples include perennial, intermittent bodies of water like lakes, reservoirs, stock ponds.

lotic—Flowing water wetlands are associated with rivers, streams and drainage ways. These riparian wetlands contain a defined channel and floodplain.

management alternative—See alternative.

migration—Regular extensive, seasonal movements of birds between their breeding regions and their wintering regions; to pass usually periodically from one region or climate to another for feeding or breeding.

migratory birds—Birds that follow a seasonal movement from their breeding grounds to their wintering grounds. Waterfowl, shorebirds, raptors, and songbirds are all migratory birds.

mimic—To copy or imitate closely; to take on the appearance of.

mission—Succinct statement of purpose or reason for being.

mitigation—Measure designed to counteract an environmental impact or to make an impact less severe.

monitoring—The process of collecting information to track changes of selected parameters over time.

national wildlife refuge—A designated area of land, water, or an interest in land or water within the National Wildlife Refuge System, but does not include coordination areas; a complete listing of all units of the Refuge System is in the current "Annual Report of Lands Under Control of the U.S. Fish and Wildlife Service."

National Park Service(NPS)—A Federal agency under the Department Interior which oversees the care of the Nation's National Parks.

Natural Resources Conservation Service (NRCS)—A Federal agency under the Department of Agriculture. Formerly the Soil Conservation Service (SCS), the agency works with landowners through conservation planning and assistance designed to benefit the soil, water, air, plants, and animals that result in productive lands and healthy ecosystems.

National Wildlife Refuge System (Refuge System)—Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife including species threatened with extinction, all lands, waters, and interests therein administered by the Secretary as wildlife refuges, areas for the protection and conservation of fish and wildlife that are threatened with extinction, wildlife ranges, game ranges, wildlife management areas, and waterfowl production areas.

National Wildlife Refuge System Improvement Act of 1997 (Improvement Act)—Sets the mission and the administrative policy for all refuges in the National Wildlife Refuge System; defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation); establishes a formal process for determining appropriateness and compatibility; establishes the responsibilities of the Secretary of the Interior for managing and protecting the Refuge System; requires a comprehensive conservation plan for each refuge by the year 2012. This act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

native species—A species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.

neotropical migrant—A bird species that breeds north of the United States and Mexican border and winters primarily south of this border.

nest success—The percentage of nests that successfully hatch one or more eggs of the total number of nests initiated in an area.

nongovernmental organization—Any group that is not a Federal, State, tribal, county, city, town, local, or other governmental entity.

noxious weed, also invasive plant—Any living stage (including seeds and reproductive parts) of a parasitic or other plant of a kind that is of foreign origin (new to or not widely prevalent in the United States) and can directly or indirectly injure crops, other useful plants, livestock, poultry, other interests of agriculture including irrigation, navigation, fish and wildlife resources, or public health. According to the Federal Noxious Weed Act (Public Law 93–639), a noxious weed (can be invasive too) is one that causes disease or has adverse effects on humans or the human environment and, therefore, is detrimental to the agriculture and commerce of the United States and to public health.

NWR—National wildlife refuge.

objective—An objective is a concise target statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work; derived from goals and provide the basis for determining management strategies. Objectives should be attainable and time-specific and should be stated quantitatively to the extent possible. If objectives cannot be stated quantitatively, they may be stated qualitatively (The "Fish and Wildlife Service Manual," 602 FW 1.5).

patch—An area distinct from that around it; an area distinguished from its surroundings by environmental conditions.

perennial—Lasting or active through the year or through many years; a plant species that has a lifespan of more than 2 years.

plant community—An assemblage of plant species unique in its composition; occurs in particular locations under particular influences; a reflection or integration of the environmental influences on the site such as soil, temperature, elevation, solar radiation, slope, aspect, and rainfall; denotes a general kind of climax plant community, such as ponderosa pine or bunchgrass.

playa habitat—Wetlands that are usually described as shallow, typically round, ephemeral bodies of water with clay floors that lie in the lowest point of a closed watershed. When wet, these saline wetlands provide important habitat for many bird species.

preferred alternative—The Service's final selection (after analysis of alternatives in a draft NEPA document) of a management alternative to carry out, which is documented in a "record of decision" for an EIS or a "finding of no significant impact" for an EA and published in the Federal Register. The decision is based on the legal responsibility of the Service including the missions of the Service and the Refuge System, other legal and policy mandates, the purpose of the refuge, and the vision and goals in the final CCP. In addition, the Service considers public, tribal, and agency input along with land uses in the ecosystem, environmental effects, and budget projections.

prescribed fire—A wildland fire originating from a planned ignition to meet specific objectives identified in a written, approved, prescribed fire plan for which NEPA requirements (where applicable) have been met before ignition. These objectives could be hazardous fuel reduction, habitat- or wildlife-oriented, or other objectives in the prescribed fire burn plan.

prescriptive grazing—The planned application of livestock grazing at a specified season, duration and intensity to accomplish specific vegetation management objectives. The objectives are designed to achieve the broader habitat and wildlife goals.

priority public use—One of six uses authorized by the National Wildlife Refuge System Improvement Act of 1997 to have priority if found to be compatible with a refuge's purposes. This includes hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation.

properly functioning condition—Qualitative method for assessing the condition of riparian-wetland areas. It describes both the assessment and the conditions of the wetland area. It evaluates how well the physical processes are functioning through use of a checklist.

proposed action—The alternative proposed to best achieve the purpose, vision, and goals of a refuge (contributes to the Refuge System mission, addresses the significant issues, and is consistent with principles of sound fish and wildlife management).

public—Individuals, organizations, and groups; officials of Federal, State, and local government agencies; Native American tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have shown an interest in Service issues and those who do or do not realize that Service decisions may affect them.

public domain—Lands that were not under private or State ownership during the 18th and 19th centuries in the United States, as the country was expanding. These lands were obtained from the 13 colonies, Native American tribes, or purchases from other counties. The domain was controlled by the Federal Government and sold to States or private interests through the General Land Office, which would eventually become the Bureau of Land Management.

public involvement—A process that offers affected and interested individuals and organizations an opportunity to become informed about, and to express their opinions on, Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for refuge management.

purpose of the refuge—The purpose of a refuge is specified in or derived from the law, proclamation, Executive order, agreement, public land order, donation document, or administrative memorandum establishing authorization or expanding a refuge, a refuge unit, or a refuge subunit (The "Fish and Wildlife Service Manual," 602 FW 1.5).

quality wildlife-dependent recreation—Programs are based on 11 criteria that defined under 605 FW1, "General Guidelines for Wildlife-Dependent Recreation." Quality programs include the following—safety of participants and compliance with laws and regulations; minimized conflicts with other goals or users; accessibility, stewardship, and availability to a broad spectrum of the American people; public understanding and appreciation of the natural resources; reliable and reasonable opportunities to experience wildlife; accessible facilities that blend in with the natural setting; and visitor satisfaction to help define and evaluate programs.

raptor—A carnivorous bird such as a hawk, a falcon, or a vulture that feeds wholly or chiefly on meat taken by hunting or on carrion (dead carcasses).

refuge purpose—See purpose of the refuge.

Refuge System—See National Wildlife Refuge System.

refuge use—Any activity on a refuge, except administrative or law enforcement activity, carried out by or under the direction of an authorized Service employee.

resident species—A species inhabiting a given locality throughout the year; nonmigratory species.

resilience—The ability to absorb disturbances, to be changed and then to reorganize and still have the same identity (keep the same basic structure and ways of functioning).

rest—Free from biological, mechanical, or chemical manipulation, in reference to refuge lands.

restoration—Management emphasis designed to move ecosystems to desired conditions and processes, such as healthy upland habitats and aquatic systems.

riparian area or riparian zone—An area or habitat that is transitional from terrestrial to aquatic ecosystems including streams, lakes, wet areas, and adjacent plant communities and their associated soils that have free water at or near the surface; an area whose components are directly or indirectly attributed to the influence of water; of or relating to a river; specifically applied to ecology, "riparian" describes the land immediately adjoining and directly influenced by streams. For example, riparian vegetation includes all plant life growing on the land adjoining a stream and directly influenced by the stream.

RLGIS—Refuge land geographic information system.

SAMMS—See Service Asset Maintenance Management System.

San Luis Valley (SLV)—An extensive high-altitude basin in Colorado with a small portion overlapping into New Mexico covering about 8,000 square miles and sitting at an average elevation of 7,664 feet. It is drained to the south by the Rio Grande. The valley is about 122 miles long and 74 miles wide.

scoping—The process of obtaining information from the public for input into the planning process.

seasonally flooded—Surface water is present for extended periods in the growing season, but is absent by the end of the season in most years.

sediment—Material deposited by water, wind, and glaciers.

Service—See U.S. Fish and Wildlife Service.

Service Asset Maintenance Management System (SAMMS)—A national database that contains the unfunded maintenance needs of each refuge; projects include those required to maintain existing equipment and buildings, correct safety deficiencies for the implementation of approved plans, and meet goals, objectives, and legal mandates.

shorebird—Any of a suborder (Charadrii) of birds such as plovers or sandpipers that frequent wetlands.

shrub–grass—This habitat type occurs in areas of Baca National Wildlife Refuge that receive high amounts of subsurface irrigation from adjacent wet meadows. These areas provide valuable wetland habitat for multiple native species. It has patches of dense graminoids in the understory.

The overstory is dominated by rubber rabbitbrush, but other shrubs like greasewood may also be present.

spatial—Relating to, occupying, or having the character of space.

special status species—Plants or animals that have been identified through Federal law, State law, or agency policy as requiring special protection of monitoring. Examples include federally listed endangered, threatened, proposed, or candidate species; State-listed endangered, threatened, candidate, or monitor species; Service's species of management concern; or species identified by the Partners in Flight Program as being of extreme or moderately high conservation concern.

special use permit—A permit for special authorization from the refuge manager required for any refuge service, facility, privilege, or product of the soil provided at refuge expense and not usually available to the public through authorizations in Title 50 CFR or other public regulations (Refuge Manual, 5 RM 17.6).

species of concern—Those plant and animal species, while not falling under the definition of special status species, that are of management interest by virtue of being Federal trust species such as migratory birds, important game species, or significant keystone species; species that have documented or apparent populations declines, small or restricted populations, or dependence on restricted or vulnerable habitats.

stepdown management plan—A plan that provides the details necessary to carry out management strategies identified in the comprehensive conservation plan (The "Fish and Wildlife Service Manual," 602 FW 1.5).

strategy—A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives (The "Fish and Wildlife Service Manual," 602 FW 1.5).

suppression—All the work of extinguishing a fire or confining fire spread.

surrogate species—species that represent other species or aspects of the environment. These include umbrella, focal, keystone, indicator, and flagship species. It is a commonly-used scientific term for system-based conservation planning that uses a species as an indicator of landscape habitat and system conditions.

target species—A species selected, because of specific biological or social reasons, for management and monitoring. A target species could be a focal, endangered, big game, or other species.

TES—Threatened and endangered species.

threatened species, Federal—Species listed under the Endangered Species Act of 1973, as amended, that are likely to become endangered within the foreseeable future throughout all or a significant part of their range.

threatened species, State—A plant or animal species likely to become endangered in a particular State within the near future if factors contributing to population decline or habitat degradation or loss continue.

travel corridor—A landscape feature that facilitates the biologically effective transport of animals between larger patches of habitat dedicated to conservation functions. Such corridors may facilitate several kinds of traffic including frequent foraging movement, seasonal migration, or the once in a lifetime dispersal of juvenile animals. These are transition habitats and need not contain all the habitat elements required for long-term survival or reproduction of its migrants.

trust resource—See Federal trust resource.

trust species—See Federal trust species.

ungulate—A hoofed mammal such as horses, cattle, deer, elk, pronghorn, and bighorn sheep.

U.S.C.—United States Code.

USDA—U.S. Department of Agriculture.

USDA Forest Service (USFS)—A Federal agency under the Department of Agriculture which oversees management of national forests.

U.S. Fish and Wildlife Service (Service, USFWS, FWS)—The principal Federal agency responsible for conserving, protecting, and enhancing fish and wildlife and their habitats for the continuing benefit of the American people. The Service manages the 93-million-acre National Wildlife Refuge System comprised of more than 530 national wildlife refuges and thousands of waterfowl production areas. It also runs 65 national fish hatcheries and 78 ecological service field stations, the agency enforces Federal wildlife laws, manages migratory bird populations, restores national significant fisheries, conserves and restores wildlife habitat such as wetlands, administers the Endangered Species Act, and helps foreign Governments with their conservation efforts. It also oversees the Federal aid program that distributes millions of dollars in excise taxes on fishing and hunting equipment to State wildlife agencies.

USFWS—See U.S. Fish and Wildlife Service.

U.S. Geological Survey (USGS)—A Federal agency whose mission is to provide reliable scientific information to describe and understand the earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

USGS—See U.S. Geological Survey.

vision statement—A concise statement of the desired future condition of the planning unit, based primarily on the Refuge System mission, specific refuge purposes, and other relevant mandates (The “Fish and Wildlife Service Manual,” 602 FW 1.5).

wildfire—A wildland fire originating from an unplanned ignition caused by lightning, volcanoes, unauthorized and accidental human-caused fires, and escaped prescribed fires.

wildland fire—A general term describing any non-structure fire that occurs in the wildland.

Appendix A
Key Legislation and Policies

This appendix briefly describes the guidance for the National Wildlife Refuge System and other policies and key legislation that guide the management of the San Luis Valley National Wildlife Refuge Complex.

A.1 National Wildlife Refuge System

The mission of the Refuge System is to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. (National Wildlife Refuge System Improvement Act of 1997.)

Goals

- Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.

- Develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life history needs of these species across their ranges.

- Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts.

- Provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fish, wildlife observation and photography, and environmental education and interpretation).

- Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.

Guiding Principles

There are four guiding principles for management and public use of the Refuge System established by Executive Order 12996 (1996):

- Public Use—The Refuge System provides important opportunities for compatible wildlife-dependent recreational activities involving hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

- Habitat—Fish and wildlife will not prosper without quality habitat, and without fish and wildlife, traditional uses of refuges cannot be sustained. The Refuge System will continue to conserve and enhance the quality and diversity of fish and wildlife habitat within refuges.

- Partnerships—America's sportsmen and women were the first partners who insisted on protecting valuable wildlife habitat within wildlife refuges. Conservation partnerships with other Federal agencies, State agencies, tribes, organizations, industry, and the public can make significant contributions to the growth and management of the Refuge System.

- Public Involvement—The public should be given a full and open opportunity to participate in decisions about acquisition and management of national wildlife refuges.

A.2 Other Legal and Policy Guidance

Management actions on national wildlife refuges are constrained by many mandates including laws and Executive orders. The more common regulations that affect refuge complex management are listed below.

- American Indian Religious Freedom Act (1978): Directs agencies to consult with native traditional religious leaders to determine appropriate policy changes necessary to protect and preserve Native American religious cultural rights and practices.
- Americans with Disabilities Act (1992): Prohibits discrimination in public accommodations and services.
- Antiquities Act (1906): Authorizes the scientific investigation of antiquities on Federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.
- Archaeological and Historic Preservation Act (1974): Directs the preservation of historic and archaeological data in Federal construction projects.
- Archaeological Resources Protection Act (1979), as amended: Protects materials of archaeological interest from unauthorized removal or destruction and requires Federal managers to develop plans and schedules to locate archaeological resources.
- Architectural Barriers Act (1968): Requires federally owned, leased, or funded buildings and facilities to be accessible to persons with disabilities.
- Bald and Golden Eagle Protection Act (1940): Provides for the protection of the bald eagle (the national emblem) and the golden eagle by prohibiting, except under certain specified conditions, the taking, possession and commerce of such birds.
- Bureau of Reclamation Project Authorization Act (1972): Public Law 92-514 (Closed Basin Project) allowed for furnishing water for operation of Alamosa National Wildlife Refuge.
- Clean Air Act (1970, amended 1990): Restricts the amount of pollutants that can be emitted into the air. Designated wilderness areas including the Great Sand Dunes National Park and Preserve (adjacent to portions of Baca National Wildlife Refuge) have the highest standards (class I) for pollution and visibility.
- Clean Water Act (1977): Requires consultation with the U.S. Army Corps of Engineers (404 permits) for major wetland modifications.
- Closed Based Project (1972): BOR is authorized by Public Law 92-514 (October 20, 1972) to operate and maintain the Closed Basin Project through portion of the San Luis Valley including Alamosa and Baca Refuges for the transport of water into the Rio Grande for the fulfillment of the United States’ obligation to Mexico and for furnishing water downstream of Alamosa Refuge for deficient areas of Colorado, New Mexico, and Texas. This is accomplished through direct diversion of water out of the closed basin system.
- Data Quality Act (2001): Requires Government agencies to ensure and maximize the quality, objectivity, utility, and dissemination of information by Federal agencies.
- Dingell-Johnson Act (1950): Authorizes the Secretary of the Interior to provide financial assistance for State Fish restoration and management plans and projects. Financed by excise taxes paid by manufactures of rods, reels, and other fishing equipment.
- Emergency Wetlands Resources Act (1986): Promotes wetland conservation for the public benefit to help fulfill international obligations in various migratory bird treaties and conventions. The act authorizes buying wetlands with Land and Water Conservation Fund monies.
- Endangered Species Act (1973): Requires Federal agencies to carry out programs for the conservation of endangered and threatened species.
- Enhancement Act (2000): Public Law 106–54 authorized the Secretary of Army, working with the Secretary of Interior, to

identify cabin sites suitable for conveyance to current lessees. The funds received will be used for acquiring other lands with greater wildlife and other public value for the refuge.

- Executive Order 11988 (1977): Requires Federal agencies to provide leadership and take action to reduce the risk of flood loss, minimize the impact of floods on human safety, and preserve the natural and beneficial values served by the floodplains.

- Executive Order 12996, Management and General Public Use of the National Wildlife Refuge System (1996): Defines the mission, purpose, and priority public uses of the National Wildlife Refuge System. It also presents four principles to guide management of the Refuge System.

- Executive Order 13007, Indian Sacred Sites (1996): Directs Federal land management and other agencies

- to accommodate access to and ceremonial uses of Indian sacred sites by Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites and, where appropriate, maintain the confidentiality of sacred sites.

- Executive Order 13352, Cooperative Conservation (2004): Directs Federal agencies to implement laws relating to the environment and natural resources in a manner that promotes cooperative conservation with an emphasis on appropriate inclusion of local participation in Federal decisionmaking in accordance with respective agency missions and policies.

- Executive Order 13443, Facilitation of Hunting Heritage and Wildlife Conservation (2007): Directs Federal land management and other agencies to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat.

- Executive Order 13653, Preparing the United States for the Impacts of Climate Change (2013): Directs Federal Government agencies to build on recent progress and pursue new strategies to improve the Nation's preparedness and resilience in preparing and adapting to climate change.

- Federal Noxious Weed Act (1990): Requires the use of integrated management systems to control or contain undesirable plant species and an interdisciplinary approach with the cooperation of other Federal and State agencies.

- Federal Records Act (1950): Requires the preservation of evidence of the Government's organization, functions, policies, decisions, operations, and activities, as well as basic historical and other information.

- Fish and Wildlife Coordination Act (1958): Allows the U.S. Fish and Wildlife Service to enter into agreements with private landowners for wildlife management purposes.

- Great Sand Dunes National Park and Preserve Act (2000): Public Law 106-530 was passed by Congress on November 22, 2000. Section 6 of the Act authorized the establishment of Baca National Wildlife Refuge. It also recognized the significant diversity of resources within the Great Sand Dunes ecosystem and changed the park from its national monument status to a national park. The Act was amended in 2009 by Public Law 111-8 to provide purposes for Baca Refuge.

- Migratory Bird Conservation Act (1929): Establishes procedures for acquisition by purchase, rental, or gifts of areas approved by the Migratory Bird Conservation Commission.

- Migratory Bird Hunting and Conservation Stamp Act (1934): Authorizes the opening of part of a refuge to waterfowl hunting.

- Migratory Bird Treaty Act (1918): Designates the protection of migratory birds as a Federal responsibility, and enables the setting of seasons and other regulations including the closing of areas, Federal or non-Federal, to the hunting of migratory birds.

- Native American Policy (1994): Articulates the general principles that guide the Service's government-to-government relationship to Native American governments in the conservation of fish and wildlife resources.

- National Environmental Policy Act (1969): Requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate this act with other planning requirements, and prepare appropriate documents to facilitate better environmental decisionmaking. [From the Code of Federal Regulations (CFR), 40 CFR 1500]

- National Historic Preservation Act (1966), as amended: Establishes as policy that the Federal Government is to provide leadership in the preservation of the Nation's prehistoric and historical resources.

- National Wildlife Refuge System Administration Act (1966): Defines the National Wildlife Refuge System and authorizes the Secretary of the Interior to permit any use of a refuge, provided such use is compatible with the major purposes for which the refuge was established.

- National Wildlife Refuge System Improvement Act of 1997: Sets the mission and administrative policy for all refuges in the National Wildlife Refuge System; mandates comprehensive conservation planning for all units of the Refuge System.

- Native American Graves Protection and Repatriation Act (1990): Requires Federal agencies and museums to inventory, determine ownership of, and repatriate cultural items under their control or possession.

- Paleontological Resources Preservation Act of 2009: Requires the Secretary of Interior and Agriculture to manage and protect paleontological resources on Federal land using scientific principles and expertise.

- Refuge Recreation Act (1962): Allows the use of refuges for recreation when such uses are compatible with the refuge's primary purposes and when sufficient funds are available to manage the uses.

- Rehabilitation Act (1973): Requires programmatic accessibility in addition to physical accessibility for all facilities and programs funded by the Federal Government to ensure that any person can participate in any program.

- Rivers and Harbors Act (1899): Section 10 of this act requires the authorization of U.S. Army Corps of Engineers before any work in, on, over, or under navigable waters of the United States.

- Sangre de Cristo National Heritage Area (2009): National heritage areas are set aside by Congress. The Sangre de Cristo National Heritage Area was established in Public Law 111-11 on March 30, 2009 for the purposes of providing integrated and cooperative approach for the "protection, enhancement, and interpretation of the natural, cultural, scenic, and recreational resources of the Heritage Area."

- Volunteer and Community Partnership Enhancement Act (1998): Encourages the use of volunteers to help in the management of refuges within the Refuge System; facilitates partnerships between the Refuge System and non-Federal entities to promote public awareness of the resources of the Refuge System and public participation in the conservation of the resources; and encourages donations and other contributions.

- Wilderness Act (1964): The act (Public Law 88–577) [16 U.S.C. 1131–36]) defines wilderness as "A wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain."

Appendix B
Preparers and Contributors

This document is the result of the extensive, collaborative, and enthusiastic efforts by the members of the planning team, cooperating agencies, and other Service or agency contributors listed below.

U.S. Fish and Wildlife Service Staff Planning Team

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Mike Blenden	Project Leader, San Luis Valley National Wildlife Refuge Complex	B.S. and M.S. Wildlife Management 32 yrs.	Project coordination, organization, writing, and review
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Corinna Hanson	Deputy Refuge Manager, Baca Refuge	B.S. Criminal Justice M.S. Wildlife Ecology 5 yrs.	Writing and reviewing
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U.S. Fish and Wildlife Service Staff Planning Team

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Cooperating Agency Members

The Cooperating Agency Members Role: Primary representative(s) of respective agencies at meetings; participated in planning team meetings; helped identify issues; provided input on alternative approaches and objectives and strategies; reviewed draft planning documents and provided information as requested.

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Consultants

Name	Agency and/or Position	Education	Contributions
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Bill Mangle	ERO Resources, Natural Resources Planner, Denver, CO	B.S. History/Political Science M.S. Natural Resources Policy Planning	Assistance with analysis and research for reasonably foreseeable activities and cumulative impacts, and other NEPA documentation
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Individuals and Groups

Name	*Position and/or Agency*
Many other individuals also provided invaluable assistance with the preparation of this CCP. The Service acknowledges the efforts of the following individuals and groups toward the completion of this plan. The diversity, talent, and knowledge contributed dramatically improved the vision and completeness of this document.	
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Appendix C
Public Involvement

Following the guidance found in NEPA, the Improvement Act, and our planning policies, we have made sure that all interested groups and the public have had an opportunity to be involved in the planning process. This appendix outlines our outreach efforts during the development of the CCP and EIS.

C.1 Public Scoping Activities

A notice of intent to develop a CCP and a request for comments was published in the Federal Register on March 11, 2011(76 FR Doc. 2011-5924) (FWS 2011h). The notice of intent notified the public of our intent to begin the CCP and EIS process.

Public Outreach

Early in the preplanning phase, the Service identified a process that would be inclusive of many interests and would involve a range of activities for keeping the public informed and ensure meaningful public input. To date, the Service used various methods to solicit guidance and feedback from interested citizens, organizations, and government agencies. These methods have included outreach materials, public scoping meetings, agency meetings (planning team), briefings and presentations, as well as letters, email and telephone calls.

Planning Updates

A Planning Update was mailed to about 300 persons and businesses during the period leading up to the public meetings, and most updates were mailed in mid-March 2011 (FWS 2011h). The planning update and an earlier piece titled Planning Process Summary (FWS 2011g), outlined the planning process, the draft vision and goals for the refuge, and the dates, times and locations of the public scoping meetings. Information contained in the Planning Update was announced at local agency meetings (FWS2011h). The Planning Update distribution list consisted of individuals, agencies, and organizations who previously expressed an interest in refuge activities (FWS2011h).

Press Release

A press release announcing the planning process and notifying the public of the schedule and location of the public meetings was sent to nearly 857 media organizations throughout Colorado including congressional offices, other Federal and State agency offices, and tribal agencies. A number of news articles about the planning process appeared in a number of newspapers, radio, TV and online publications prior to the meetings. Additionally, the project leader gave a 20-minute taped radio interview with KSLV in Monte Vista, CO that aired on April 16, 2011 and another 20-minute live interview with KRZA which aired twice on April 19, 2011.

Project Website

The project's planning web site <http://www.fws.gov/alamosa/planning> was established in early March 2011 (FWS 2014X). The site provides information about the public scoping meetings, as well as downloadable versions of all of the available public scoping documents. An example of the web site is included in the scoping report (FWS2011h). All interested citizens can sign up to be on the project mailing list or can provide public comment through the planning website.

Public Scoping Meetings

The three public scoping meetings (March 29-31, 2011) were a major component of the public scoping process. The purpose of these meetings was to solicit public concerns and planning ideas that will be considered in the CCP/LPP and EIS. Meetings were held at three locations—Alamosa, Monte Vista, and Crestone.

Following a brief welcome and introduction, Service staff made a 15-minute presentation that outlined the following points:

- Description of the Service and the purpose of the Refuge System
- CCP and EIS process
- Project schedule
- Draft Vision and goals
- Proposed San Luis Valley Conservation Area and LPP

Following the presentation, the remainder of the meeting was broken up into two components, questions and answers and public comments. During the question and answer session, the facilitator took all the audience's questions. In turn, we answered all questions. Most of the meeting time was spent in the question and answer session. After all the questions were answered, we took comments from those who wanted to offer them. This format enabled participants to have their questions and concerns answered about the planning process and also identified many of the important issues.

Other Briefings

We have briefed or given a presentation to a number of entities that have included county commissioners from the affected governments, the Rio Grande Water Conservation District, and others.

For the President's America's Great Outdoor initiative, we have met with a wide array of local ranchers and stakeholders, county commissioners, State representatives, and other Federal agencies to talk about landscape conservation in the San Luis valley.

C.2 Agency and Tribal Coordination

In accordance with the Service's planning policy, the preplanning and scoping process began with formal notification to Native American tribes and other Federal and State agencies with a land management interest and inviting them to participate as cooperating agencies and members of the planning team.

Native American Tribes

We sent letters of notification about the planning process including an invitation to participate on the planning team to the following tribes: Cochiti Pueblo, Pueblo of Santa Clara, Pueblo of Laguna, Pueblo of Zuni, Pueblo of Picuris, Pueblo of San Ildefonso, Pueblo of Acoma, Pueblo of Santa Ana, Pueblo of Taos, Pueblo of Jemez, Uintah and Ouray Ute Indian Tribe, Southern Ute Tribe, Ute Mountain Tribe, Jicarilla Apache Nation, Ohkay Owingeh, and Navajo Nation. We are continuing to work with interested tribes who are interested in the planning process.

Federal, State, and Local Agencies

We sent letters of notification about the planning process including an invitation to participate on the planning team to the following agencies: NPS, BLM and USFS (San Juan Public Lands Office), NRCS, and CPW. Subsequently, we met and briefed the six counties within the refuge boundaries about the planning process including the proposed San Luis Valley Conservation Area. The counties include: Alamosa, Rio Grande, Saguache, Conejos, Costilla, and Mineral counties.

Cooperating Agencies

Following notification to Native American tribes and Federal, State, and local agencies, the following agencies have participated as cooperating agencies in the development of the draft CCP and EIS: Bureau of Land Management (BLM) and the Forest Service (USFS) (both agencies are part of the San Juan Public Lands Center), National Park Service (NPS), Natural Resources Conservation Service (NRCS), Colorado Parks and Wildlife (CPW), and the Colorado Division of Water Resources. They have provided input on vision and goal, alternatives development, objectives development, and internal review of the draft CCP and EIS. We have greatly valued the input that we have received from the cooperating agencies in guiding the development of the draft CCP and EIS.

C.3 Scoping Results

The following summarizes the methods for comment collection and analysis, the number and source of comments received and a summary of the comments. The planning team collected comments, questions and concerns about the future of the refuge through public meetings, letters, email, and other methods as described in the public scoping activities above.

Methods for Comment Collection and Analysis

The objective of the scoping process is to gather the full range of comments, questions and concerns that the public has about management of the refuge or the planning process. All comments, questions, or issues, whether from written submissions or recorded at the public meetings were organized by topic into a spreadsheet and coded for organizational purposes. Every effort was made to document all issues, questions, and concerns. Regardless of whether comments and questions were general in nature or about specific points of concern, they were added to the spreadsheet one time.

We provided optional questions to the public that included the following:

- What suggestions do you have for managing migratory birds on the refuges in the face of climate change and declining precipitation?
- What ideas do you have regarding visitor services and wildlife-dependent public uses on the refuges, particularly Baca National Wildlife Refuge which is currently closed to any public use?
- What changes, if any, would you like to see in the management of the Alamosa and Monte Vista National Wildlife Refuges?
- What concerns do you have regarding the additional protection of wildlife and wetland habitat in the San Luis Valley? Can the use of conservation easements protect important wildlife resources in the valley?
- What concerns do you have regarding ungulate management on the refuges or the reintroduction of species such as the American bison?

All comments received from individuals on Service NEPA documents become part of the official public record. Requests for information contained in comments are handled in accordance with the Freedom of Information Act, NEPA (40 CFR 1506.6 (f)) and other Department of Interior and Service policies and procedures.

Summary of the Scoping Comments

During the initial scoping process, we received input on a wide array of topics and subtopics. Comments were submitted in writing and/or offered at the public meetings held in March 2011 in Alamosa, Monte Vista, and Moffat, Colorado.

Fifty-two people attended the three public meetings with the largest audience at the meeting in Moffat where about 33 people attended (10 at Alamosa and 9 at Monte Vista). Additionally, about 14 organizations and citizens provided written comments. Agency or organizations included the Environmental Protection Agency, Defenders of Wildlife, TNC, Lexam, and their legal firm.

Subsequently, we identified seven significant issues or topics to address (refer to chapter 1, section 1.7):

- Habitat and Wildlife Management
- Water Resources
- Landscape Conservation and Protection
- Visitor Services
- Partnerships and Operations
- Cultural Resources and Tribal Coordination
- Research, Science and Protection of the Physical Environment

C.4 Development of Draft Alternatives

We consider alternatives development as part of an iterative process in the development of a draft CCP and EIS, meaning it continues to evolve. This phase of the project began in the fall of 2011. The core planning team developed four approaches to managing the refuge complex. This included three action alternatives including a proposed action and the no-action alternative. Each of the draft alternatives presented a different approach for future management with a varied focus on wildlife and habitat management and visitor services. Following further input from other Service staff and our cooperating agencies, we sought further input from the public during three workshops that we held from January 23-25, 2012. Similar to the initial scoping meetings, we mailed out a planning update and put out a press release. Forty-one people attended these workshops held in Alamosa, Monte Vista, and Moffat, Colorado. We also received several hundred written comments from individuals and stakeholder groups. This input shaped further development and refinement of the alternatives.

C.5 List of Entities Receiving the Draft CCP and EIS

The following Federal and State agencies, Tribes, and nonprofit organizations received copies of the Draft CCP and EIS. Other interested groups and members of the public who were on our mailing list received a copy of Planning Update, Issue 3, which summarized the contents of the Draft CCP and EIS, announced the locations and times of the public meetings, and provided information on how to obtain a copy of the CCP and EIS.

Federal Elected Officials

- U.S. House of Representatives, Colorado Representative Scott Tipton
- U.S Senate, Colorado Senator Mark Udall
- U.S. Senate, Colorado Senator Michael Bennet

Federal Agencies

- Bureau of Land Management, San Luis Valley Field Office, Saguache, Colorado
- Bureau of Reclamation, Alamosa, Colorado
- Environmental Protection Agency, Region 8, Denver, Colorado
- National Park Service, Mosca, Colorado
- Natural Resources Conservation Service, Alamosa and Center, Colorado
- U.S. Forest Service, Rio Grande National Forest, Monte Vista Colorado
- USGS, Fort Collins, Colorado

Tribes

- Jicarilla Apache Nation, Dulce, NM
- Navajo Nation, Window Rock, AZ
- Pueblo of Acoma, Acoma, NM
- Pueblo of Cochiti, Cochiti, NM
- Pueblo of Jemez, Jemez, Pueblo, NM
- Pueblo of Laguna, Laguna, NM
- Pueblo of Picuris, Penasco, NM
- Pueblo of San Ildefonso, Santa Fe, NM
- Pueblo of Santa Clara, Espanola, NM
- Pueblo of Taos, Taos, NM
- Pueblo of Zuni, Zuni, NM
- Pueblo of Santa Ana, Santa Ana Pueblo, NM
- Southern Ute Tribe, Ignacio, CO
- Uintah and Ouray Ute Indian Tribe, Fort Duchesne, UT
- Ute Mountain Ute Tribe, Towaoc, CO

Colorado Elected Officials

- John Hickenlooper, Governor, Denver, CO
- Representative Edward Vigil, Denver, CO
- Senator Larry Crowder, State Senator, Denver, CO

Colorado State Agencies

- Colorado Division of Water Resources, Division 3, Alamosa, CO
- Colorado Parks and Wildlife, Monte Vista, CO
- Colorado State Historic Preservation Office

Local Government

- County Commissioner Alamosa County, Alamosa, CO
- County Commissioner, Conejos County, Conejos, CO
- County Commissioner, Costilla County, San Luis, CO

- County Commissioner, Mineral County, Creede, CO
- County Commissioner, Rio Grande County, Del Norte, CO
- County Commissioner, Saguache, CO
- Mayor, Alamosa, CO
- Mayor, Monte Vista, CO
- Mayor, Saguache, CO
- Rio Grande Water Conservation District, Alamosa, CO
- Town of Crestone, Crestone, CO
- Del Norte Town Government, Del Norte, CO

Public Libraries

- Alamosa Public Library, Alamosa, CO
- Carnegie Public Library, Monte Vista, CO
- Baca Grande Library, Crestone, CO
- Saguache Public Library, Saguache, CO
- Colorado State University Morgan Library, Fort Collins, CO
- U.S. Fish and Wildlife Service, National Conservation Training Center Library, Shepherdstown, West Virginia

Organizations

- The Nature Conservancy, Boulder, CO
- American Bird Conservancy, Washington, DC
- Wilderness Society, Colorado headquarters, Denver, CO
- Friends of the San Luis Valley National Wildlife Refuges, CO
- Rio Grande Headwaters Land Trust, Del Norte, CO
- Colorado Open Lands, Lakewood, CO
- Orient Land Trust, Villa Grove, CO
- San Luis Valley Ecosystem Council, Crestone, CO
- Baca Grande Property Owners Association, Crestone, CO
- Crestone Baca Land Trust, Crestone, CO

Appendix D
Compatibility Determinations

D.1 USES

We have developed draft compatibility determinations for the following existing and proposed uses. As per our planning policy, we provide these compatibility determinations in our draft CCP and EIS as part of the public review. These draft compatibility determinations only apply to the draft proposed action. Refer to chapter 1, section 1.2 for more information on compatible refuge uses.

- Hunting
- Fishing
- Wildlife observation, photography, environmental education, and interpretation
- Commercial photography
- Prescribed grazing and haying
- Cooperative farming (Monte Vista National Wildlife Refuge)
- Research

D.2 Refuge Names

The San Luis Valley National Wildlife Refuge Complex (refuge complex) consists of three national wildlife refuges:

- Monte Vista National Wildlife Refuge
- Alamosa National Wildlife Refuge
- Baca National Wildlife Refuge

D.3 Establishing and Acquisition Authorities

The following laws and Executive orders established the refuges and authorized acquisition of refuge lands.

Monte Vista National Wildlife Refuge

- Establishing authority: Migratory Bird Conservation Act of 1929
- Approved for acquisition on June 10, 1952, by the Migratory Bird Conservation Commission
- Public Land Order 2204 dated September 1960

Alamosa National Wildlife Refuge

- Establishing authority: Migratory Bird Conservation Act of 1929
- Approved for acquisition on June 27, 1962, by the Migratory Bird Conservation Commission
- Public Land Order 3899 dated December 1965

Baca National Wildlife Refuge

- Establishing authority: Great Sand Dunes National Park and Preserve Act of 2000 (Public Law 106-530, November 22, 2000)
- Established on April 8, 2003, with transfer of 3,315 acres from BOR

D.4 Refuge Purposes

Monte Vista and Alamosa National Wildlife Refuges

The Monte Vista and Alamosa National Wildlife Refuges (refuges) were established "for use as an inviolate sanctuary, or for any other management purposes, for migratory birds" (16 U.S.C.§ 715d (Migratory Bird Conservation Act).

Baca National Wildlife Refuge

The Baca Refuge was established "to restore, enhance, and maintain wetland, upland, riparian, and other habitats for native wildlife, plant, and fish species in the San Luis Valley" (Omnibus Appropriations Act, 2009, H.R. 1105).

National Wildlife Refuge System Mission

The mission of the Refuge System is "to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

D.5 Description of Use

Hunting

The refuge complex proposes to continue to provide safe and sustainable waterfowl and small game hunting opportunities within designated areas of the Alamosa and Monte Vista Refuges. In addition, we propose to expand big game hunting opportunities on the Alamosa and Monte Vista Refuges and open the Baca Refuge to both big and small game hunting.

Under the authority of the National Wildlife Refuge Administration Act, the Secretary of the Interior can authorize hunting on any unit of the National Wildlife Refuge System (Refuge System) as long as it is compatible with the purposes for which the refuge was established. This act also allows waterfowl hunting on up to 40 percent of land acquired under the Migratory Bird Conservation Act that would otherwise be considered "inviolate sanctuary." Both the Alamosa and Monte Vista Refuges were acquired with funds generated from the sale of Migratory Bird Hunting and Conservation Stamps ("Duck Stamps"). Consequently, portions of both refuges are open to waterfowl hunting in compliance with all applicable State and Federal laws. In addition to waterfowl hunting, hunting for pheasant, cottontail, and jackrabbit is permitted during established waterfowl hunting seasons within the areas of each refuge designated for waterfowl hunting.

For all practical purposes, elk were not present on the Alamosa and Monte Vista Refuges during the first 40 years after the establishment of the refuges. It was not until the mid-1990s that elk starting using Monte Vista Refuge in noticeable numbers. During the late 1990s, elk started using the Alamosa Refuge. Elk hunting has never been opened to the public on either of these refuges.

As a consequence of the change in elk distribution and abundance on the Alamosa and Monte Vista Refuges, we are proposing some elk hunting on both refuges. The CCP provides the first opportunity in the history of the Baca Refuge to consider making refuge hunting opportunities available to the public. We propose opening small game hunting, as defined by Colorado hunting regulations, in the southwest and northwest portions of the refuge (figure 18) and an elk archery season both along and to the north of Crestone Creek. Additional elk hunting opportunities would be made available following additional planning.

On all three refuges, we propose working with CPW to conduct dispersal hunts to redistribute concentrations of elk that are excessively damaging refuge resources or private property or that are presenting unusual hazards on nearby public roads. These hunts would use licensed hunters to eliminate stubborn management conflicts when all conventional efforts have failed. Hunters would be accompanied by agency personnel and instructed about which animals to take to meet management objectives.

Availability of Resources

We currently have a full-time law enforcement officer and two collateral duty officers to help administer the hunting program. Additionally, law enforcement assistance would continue to be provided by CPW.

Anticipated Impacts of Use

As with all hunting programs that use firearms, human safety and the potential for property damage are important considerations. Hunters, other refuge users, and refuge staff are exposed to potential hazards whenever firearms are present. Damage and theft of cultural resources are potential impacts whenever people, including hunters, are in areas with these resources. Harvest of individual animals can have negative impacts on larger populations if sustainable harvest practices are not used. Hunting activity in one area of a refuge often causes animals to move to other portions of the refuge or to neighboring private or public lands. In developing a sustainable waterfowl hunting program, we must consider the response of waterfowl to hunting, and we often maintain areas that are closed to hunting along with areas where hunting is allowed.

Determination

Hunting, including big game, waterfowl, and small game hunting, is a compatible use of the Alamosa, Baca, and Monte Vista Refuges.

Stipulations Necessary To Ensure Compatibility

- Plans for specific hunting programs would ensure reasonable human safety by maintaining hunter densities at or below reasonable levels, providing information to hunters regarding the areas they are hunting in and associated conditions, and maintaining law enforcement and staff presence to enable response to emergencies and provide information in the field.

- Plans for specific hunting programs would exclude areas from hunting activity if there is a substantial risk of property damage from firearm discharge.

- Illegal activities, including hunting violations and removal of cultural artifacts, would be minimized by providing well thought-out information and sufficient law enforcement presence.

- All hunting programs would consider population objectives. Waterfowl hunting would follow seasons and bag limits provided by CPW.

- Plans for specific programs would include objectives for elk distribution. In some cases, discouraging elk use of some parts of a refuge may be a major objective of the hunt. In other cases, it would be desirable to prevent movement of elk off a refuge onto the adjoining Great Sand Dunes National Park and Preserve or private lands.

- All hunting programs would be coordinated with CPW.

- The refuge manager would have the ability to close or modify entire hunting programs, including access, timing, and methods, in response to unforeseen conditions in order to ensure public safety and best management of natural resources.

- Refuge staff would regularly solicit feedback from hunters regarding safety, the overall quality of their hunting experiences, and any suggestions they may have.

Justification

Within the refuge complex, expansion of the current hunting program would provide diverse and quality hunting opportunities for waterfowl, big game, and small game hunting, as defined in the Service's guidelines for wildlife-dependent recreation (FWS 2006). Under this policy, providing quality experiences is highlighted as an important component of a hunting program (605 FW1, 605FW2). Promoting safety, providing reasonable opportunities for success, and working collaboratively with the State wildlife agencies are just a few of the key elements that should be considered in providing for quality experiences. For example, a quality experience could mean that participants could expect reasonable harvest opportunities, uncrowded conditions, few conflicts between hunters, relatively undisturbed wildlife, and limited interference from, or dependence on, mechanized aspects of the sport.

Hunting has long been an important cultural and social component of the lands that make up the refuge complex. About 800 to 1,000 hunters visit the Alamosa and Monte Vista Refuges each year, and these refuges would continue to provide for quality and diverse hunting experiences. The opening of the Baca Refuge would provide welcome hunting opportunities for many hunters. On all three refuges, elk hunting is a badly needed tool which would improve the ability of refuge managers to influence the distribution of elk on the refuges and assist CPW in achieving population objectives.

Mandatory 15-year reevaluation date: 2030

Fishing

Throughout most of the history of Monte Vista Refuge, the Service has hosted an annual "Kids Fishing Day." Over the years, the event has had several participating partners. Since 2000, it has been sponsored by the Friends of the San Luis Valley National Wildlife Refuges (Friends group). This event is scheduled to occur on a Saturday in June close to or during National Fishing Week, with the objective of introducing youth to fishing and wildlife-dependent activities while providing environmental education regarding cold-water fisheries and national wildlife refuges.

Kids Fishing Day is conducted at a shallow, two-acre pond that is a remnant of a fish hatchery that operated before the refuge was acquired. Typically, the pond is filled with water from an adjoining well several weeks in advance. Approximately 1 week prior to the event, approximately 1,000 fish donated from the Hotchkiss National Fish Hatchery are introduced into the pond. Public service announcements and fliers posted in local communities indicate required adult supervision, announce a free lunch, and describe the educational displays or presentations, which vary from year to year depending on the availability of presenters and cooperators. Volunteers and refuge staff are present to assist young anglers when needed and to ensure public safety.

Other service organizations including a private, non-profit mental health agency, and a number of retirement and assisted living facilities are then allowed to bring groups to the pond after the Kids Fishing Day event to take advantage of any remaining angling opportunities in the safe and accessible environment. This event also provides additional opportunities for appreciation of wildlife-dependent recreation to an underserved segment of the public.

Availability of Resources

This event does not require a large amount of refuge resources. The fish are donated and delivered by the Hotchkiss National Fish Hatchery. Organization and execution of the event is largely conducted by the Friends group with help from varying partners. The largest refuge expense is the electricity used to pump water when surface water is unavailable.

Anticipated Impacts of Use

All water used for this event and not lost to evaporation goes into the Spring Creek system of the Monte Vista Refuge, which then provides some benefit to wetlands. About 5 acres of short emergent wetland habitat could be maintained if this same amount of water was directly used for that purpose.

Determination

Conducting the Kids Fishing Day event is a compatible use of Monte Vista Refuge.

Stipulations Necessary To Ensure Compatibility

Stipulations required include:

- the event continues to be well supported by the Friends of the San Luis Valley National Wildlife Refuges and other partners
- reliance on groundwater for this event is minimized by maintaining the pond for as short a period as possible while allowing harvest of most of the fish and providing the greatest angling opportunity
- fish continue to be donated from the Hotchkiss National Fish Hatchery or equivalent
- fish remaining in the pond are donated to CPW for placement in other approved fisheries such as nearby Homelake State Wildlife Area

Justification

Fishing is one of the wildlife-dependent recreational activities that is encouraged on national wildlife refuges and is a fundamental strategy in the Service's "Connecting People with Nature" effort. Although this fishing event is provided in a somewhat artificial setting, it is a very popular and accessible opportunity in a community that otherwise must drive extensive distances for similar experiences, which may not be possible for youth from lower-income families. The cost of conducting this small, short-term event is well worth the benefit to the community and achieving Refuge System goals.

Mandatory 15-year reevaluation date: 2030

Wildlife Observation, Photography, Interpretation, and Environmental Education

The Improvement Act identified six wildlife-dependent recreational activities as priority public uses and encouraged their implementation on refuges when they are found compatible with refuge purposes and when adequate resources are available to manage these activities on refuge lands. This compatibility determination considers wildlife observation, wildlife interpretation, environmental education, and wildlife photography. The compatibility of the other two activities identified in the Act, hunting and fishing, are assessed above.

Compatible access for priority public uses would be improved on the Monte Vista and Alamosa Refuges and established on the Baca Refuge. On the Monte Vista and Alamosa Refuges, we would allow more access for viewing and interpretation on a seasonal basis from about July 15 to February 28. Modes of access that facilitate wildlife-dependent uses—walking, cross-country skiing and bicycles—would be favored on all three refuges. Portions of the Baca Refuge would be seasonally opened for all public uses except fishing. An auto tour route would be built on the Baca Refuge. Additional trails or viewing platforms could be considered to enhance viewing opportunities. Limited commercial opportunities such as photography could be considered. We would seek funding to build a visitor center and refuge complex staff offices at the Monte Vista Refuge to better serve the public, provide for safer access to our offices, and create a more efficient work environment for our employees.

On the Alamosa Refuge, we would:

- extend the auto tour route to the east to connect with the Bluff Road; improve the accessibility of the Rio Grande nature trail and enhance the experience by providing better seating, shelter, and interpretation for visitors; seasonally open about 7.3 additional miles of existing trails and administrative roads for wildlife viewing and photography access (foot, bicycle, cross country ski) currently available only to hunters during the hunting season; and open about 6.4 additional miles of nature trails, including a trail link to town and an extension of Bluff Nature Trail to parking lot 4
- work with partners to develop a trail from the town of Alamosa to the Alamosa Refuge
- repurpose the existing contact station and visitor center at the Alamosa Refuge to focus on environmental education and administrative needs

On the Baca Refuge, we would:

- develop auto tour routes and install wayside interpretive panels along these routes. Auto tour routes would provide seasonal access and allow visitors to experience different habitats on the refuge. These routes would be accessible from Colorado Highway 17 and Saguache County Road T.
- develop a looped interpretive trail around the refuge's headquarters area (old Baca Ranch) with several interpretive panels or other interpretive media positioned along the trail route
- develop a nature trail from the refuge office to the sandy bluff and windmill above the office, as well as a trail through the pinion unit uplands with access from the Baca Grande subdivision. This trail would accommodate horse traffic as well as foot traffic
- develop two nature trails originating from the historic Cottonwood Cow Camp, where there would also be a picnic spot with table(s) and a vault toilet
- develop two picnic spots (without toilets) at the refuge headquarters and one at the historic Sheds Cow Camp
- develop three elevated wildlife viewing areas along the auto tour routes and along the Baca Grande subdivision access road
- develop seven seasonal access parking areas along the western boundary of the refuge
- develop a pullout with an informational kiosk along Saguache County Road T
- provide a refuge office and visitor center and work with agency partners, Friends group, and others to staff and provide orien-

tation and interpretation for natural and cultural resources throughout the San Luis Valley. This office and visitor center would also house impressive archeological collections and provide opportunities for the public to view and learn about these artifacts.

- seasonally open portions of the refuge to big game hunting and other wildlife-dependent uses, with all using non-motorized forms of access during normal elk hunting seasons

- open proposed big game hunting areas to all non-motorized forms of access during the elk season

On the Monte Vista Refuge we would:

- improve the accessibility of the Meadowlark Nature Trail and add a viewing blind; replace information kiosks at three parking areas; develop visitor facilities around Parker Pond, including an accessible parking area and trailhead, viewing blind, trail, and observation platform; develop one crane observation pull-off and parking along Rio Grande County Road 6 South; and replace signs at existing crane observation pull-offs.

- build a new visitor center and refuge complex headquarters facility. We would link trails from this facility to the Meadowlark Nature Trail, the auto tour route and other destinations.

- work with partners to develop a trail from the town of Monte Vista to the Monte Vista Refuge

- work with BLM and Rio Grande County to develop a trailhead on Rio Grande County Road 6 South to provide non-motorized access to BLM land

On all three refuges we would:

- construct additional recreational vehicle pads for volunteers

Availability of Resources

We would mostly use existing funding and staffing to implement some of the projects that only require opening an administrative road to non-motorized access or extending an auto tour route along existing roads. Most of these projects would potentially be funded through traditional appropriated funds as they become available. Their availability depends on annual appropriations and on the degree to which refuge staff succeed in competing for any of the Service's flexible funding opportunities. Additionally, the generation of outside funding, "in-kind" assistance from partners, especially the Friends group, would also be used.

Once implemented, these projects would result in a significant increase in visitor use at all three refuges, placing a significant demand on refuge maintenance and law enforcement programs. Additional positions and maintenance funds required to sustain these projects are identified in the CCP.

Anticipated Impacts of Use

Projects on all three refuges could have the following impacts:

- On the Alamosa Refuge, additional wildlife disturbance could occur from extension of the auto tour route, opening areas for non-motorized access, expansion of wildlife viewing nature trails, and providing a trail link from the town of Alamosa to the refuge.

- On all three refuges, the proposed projects would increase human presence in both time and space. There is inter- and intra-specific variation within and among wildlife species since some species, especially habitat specialists, are more susceptible than others to human disturbance, especially habitat generalists. Research has shown that human presence associated with roads and trails can result in a simplification of avian communities (fewer specialists and more generalists), reduced nest success, and reduced habitat quality. Many species are more likely to flush with increased human presence, resulting in less time spent foraging, which can affect building suitable energy reserves for egg laying and migration, reduced food delivery rates to young, territory establishment and defense, and mate attraction. For many species, especially medium-sized and large mammals, the presence of dogs can greatly magnify the effects of disturbance. Research has shown that various activities result in differing levels of disturbance. Pedestrian and bicycle use results in greater disturbance than vehicle use. Trails and roads create habitat edges, which lead to increased predation, cowbird parasitism, and displacement of interior-sensitive birds. Trails and roads can restrict animal movement and dispersal. A corresponding increase in law enforcement resources would be required to ensure public safety.

- On the Alamosa Refuge, repurposing the visitor center and contact station would result in more use of the facility.

- On the Baca Refuge, the development of the auto tour routes and trails would result in increased disturbance to migratory birds, elk, pronghorn, and mule deer. Additionally, large movements of amphibians, primarily Great Plains toad, have occurred under some environmental conditions on the Baca Refuge. During these mass movements, it is impossible to avoid direct mortality from vehicles.

- On the Baca Refuge, increased public access comes with a greater concern about accidental destruction and intentional illegal collection of cultural artifacts commonly found on the refuge. This could also occur on the Monte Vista and Alamosa Refuges.

- On the Baca Refuge, the proposed auto tour route could increase the likelihood of visitors becoming stranded in relatively remote areas.

- On the Monte Vista Refuge, development of year-round access to Parker Pond could increase disturbance to an important waterbird nesting colony.

- On the Monte Vista Refuge, some additional disturbance would be associated with development of observation areas along County Road 6.

- Some additional disturbance would result from any non-motorized trail extending from the city of Monte Vista onto the refuge.

- Construction of a new office and visitor center would create a larger footprint than the existing small office and contact station.

Determination

Wildlife interpretation, environmental education, wildlife photography, and wildlife observation are compatible uses of the Alamosa, Baca, and Monte Vista Refuges.

Stipulations Necessary To Ensure Compatibility

Stipulations required on the Alamosa Refuge include:

- Riparian habitat acquired in 2003 with the Lillpop addition was purchased with funds provided by BOR as mitigation for southwestern willow flycatcher habitat lost from the construction and operation of the Salt River Project in Arizona. Consequently, southwestern willow flycatchers are a priority management goal on this tract and destruction of habitat and disturbance of nesting birds must be minimized by careful siting and timing of projects and associated disturbance.

- Additional limited non-motorized access to the refuges would be allowed outside of the critical breeding period from July 15th to the end of waterfowl season (end of February).

- Leashes are required for all dogs not actively being used for hunting.

- Existing administrative roads and trails would be used as much as possible in the expansion of non-motorized access to the refuge, which would minimize ground disturbance, associated habitat loss, and the spread of weeds.

- Additional volunteer recreational vehicle pads would be located in areas that are already disturbed and that are near existing administrative facilities to minimize soil and wildlife disturbance.

- The refuge manager could terminate or modify any activity if conditions change or assumptions in this analysis are found incorrect, resulting in the activity materially interfering with refuge purposes.

- Interpretive information would be posted and included in refuge brochures describing the impact of disturbance on wildlife and simple practices for the visitor to minimize disturbance.

Stipulations required on the Baca Refuge include:

- Visitors on the auto tour route would be restricted to their vehicles or the immediate area outside their vehicle.

- Refuge staff would temporarily close the auto tour route during times of significant amphibian movement to prevent toad mortality.

- Visitors on the wildlife observation trail(s) would be required to stay on the trail and keep their dogs on a leash.

- Existing administrative roads and trails would be used as much as possible in the expansion of non-motorized access to the refuge, which would minimize ground disturbance, associated habitat loss, and the spread of weeds.

- Law enforcement presence on the refuge must correspond to the amount of public use to minimize poaching, habitat destruction from off-road driving, and illegal collection of artifacts. Law enforcement presence would also have to increase to ensure that the public has a reasonable expectation of safely when visiting the refuge. Much of the Baca Refuge is relatively isolated from busy roads and people, resulting in a potentially life-threatening situation if visitors and users become stranded due to injury, mud, snow, or break down. Tour routes would be closed during times when conditions pose a significant threat to public safety.

- The use of horses would be restricted to all areas open to non-motorized access and where horses are permitted.

- Additional volunteer recreational vehicle pads would be located in areas that are already disturbed and are near existing administrative facilities to minimize soil and wildlife disturbance.

- The refuge manager could terminate or modify any activity if conditions change or assumptions in this analysis are found to be incorrect, resulting in the activity materially interfering with refuge purposes.

- Interpretive information would be posted and included in refuge brochures describing the impact of disturbance on wildlife and simple practices for the visitor to minimize disturbance.

Stipulations required on the Monte Vista Refuge include:

- Additional non-motorized access to the refuges would be allowed during the non-critical breeding period from July 15th to the end of February.

- The new visitor center and office would be built on land previously disturbed by farming activity and on the current administrative area occupied by the old office and parking lot.

- Existing administrative roads and trails would be used as much as possible in expansion of non-motorized access to the refuge, which would minimize ground disturbance, associated habitat loss, and the spread of weeds.

- Additional volunteer recreational vehicle pads would be located in areas that are already disturbed and are near existing administrative facilities to minimize soil and wildlife disturbance.

- Interpretive information would be posted and included in refuge brochures describing the impact of disturbance on wildlife and simple practices for the visitor to minimize disturbance.

Justification

The abundant wildlife resources found on the refuge complex attract many visitors to the San Luis Valley. The largest draw is the Monte Vista Crane Festival, which attracts thousands of people annually during the spring migration of sandhill cranes. This event, which is put on in partnership with the Friends group and the local community, provides a significant boost to the local economy. Other visitors frequent the auto tour routes at the Monte Vista and Alamosa Refuges, walk the nature trails, or enjoy the spectacular vistas from the Bluff Overlook at the Alamosa Refuge. The Service is unable to open the Baca Refuge to significant public access without the benefit of a planning process with public participation. Overall, access for visitors wanting to participate in nonconsumptive recreation on these three refuges has been limited. It is clear from talking with visitors and community members and from a USGS visitor survey of the Monte Vista Refuge that there is a substantial demand for more opportunities for public access on these refuges. It is the intent of this determination and the CCP to provide well-thought-out and desirable access opportunities without materially interfering with achievement of refuge wildlife management goals.

Mandatory 15-year reevaluation date: 2030

Commercial Photography

The San Luis Valley offers several photogenic wildlife spectacles such as the sandhill crane migration, elk herds, and waterfowl concentrations, with a stunning backdrop provided by the San Juan Mountains and the Culebra and Sangre de Cristo Ranges. Wildlife observation areas, hiking trails, and auto tour routes are available on the Alamosa and Monte Vista Refuges, while similar opportunities are being proposed in the CCP for the Baca Refuge. Commercial photographers and videographers regularly visit the San Luis Valley.

Commercial filming is defined as the digital recording or filming of a visual image or sound recording by a person, business, or other entity for a market audience, such as for a documentary, television or feature film, advertising, or similar project. It does not include news coverage or visitor use. Still photography is defined as the capturing of a still image on film or in a digital format. These descriptions and further information about these activities are found in 43 CFR Part 5 (Department of the Interior) and 50 CFR Part 27 (Fish and Wildlife Service).

Under the Code of Federal Regulations (50 CFR § 27.71), special use permits for commercial filming and still photography are required when "it takes place at location(s) where or when members of the public are generally not allowed; or (2) it uses model(s), sets(s), or prop(s) that are not a part of the location's natural or cultural resources or administrative facilities; or (3) the agency would incur additional administrative costs to monitor the activity; or (4) the agency would need to provide management and oversight to:

i. avoid impairment or incompatible use of the resources and values of the site; or
ii. limit resource damage; or
iii. minimize health or safety risks to the visiting public."

These permit requests are evaluated on an individual basis, using a number of Department of the Interior, Service, and National Wildlife Refuge System policies (for example, 43 CFR Part 5, F0 CFR Part 7, 8 RM 16). Commercial filming would be managed on the refuges through the special use permitting process to minimize the possibility of damage to cultural or natural resources or interference with other visitors to the area.

Availability of Resources

In general, the refuge would normally incur no expense except administrative costs for review of applications, issuance of a special use permit, and staff time to conduct compliance checks. Special use permits for commercial filming and still photography would require payment of a location fee and a reimbursement for actual costs incurred in processing the permit request and administering the permit.

Anticipated Impacts of Use

Wildlife photographers and filmmakers tend to create the largest disturbance impacts of all wildlife observers (Dobb 1998, Klein 1993, Morton 1995). While wildlife observers frequently stop to view species, wildlife photographers and cinematographers are more likely to approach wildlife (Klein 1993). Even a slow approach by wildlife photographers tends to have behavioral consequences on wildlife species (Klein 1993). Other impacts include the potential for photographers to remain close to wildlife for extended periods of time in an attempt to habituate the wildlife subjects to their presence (Dobb 1998) and the tendency for photographers to use low-power lenses to get much closer to their subjects (Morton 1995). This usually results in increased disturbance to wildlife and habitat. Handling of animals and disturbing vegetation (such as cutting plants and removing flowers) is prohibited on national wildlife refuges.

A special use permit request would be denied if the commercial filming, audio recording, or still photography activities are found not to be compatible with refuge purposes.

Determination

Commercial filming, audio recording, and still photography are compatible uses of the Alamosa, Baca, and Monte Vista Refuges.

Stipulations Necessary To Ensure Compatibility

- All commercial filming requires a special use permit.

- Special use permits would identify conditions that protect the refuges' values, purposes, and resources; ensure public health and safety; and prevent unreasonable disruption of the public's use and enjoyment of the refuge. Such conditions may be specifying road conditions when access would not be allowed, establishing time limitations, and identifying routes of access into refuges. These conditions would be identified to prevent excessive disturbances to wildlife, damage to habitat or refuge infrastructure, or conflicts with other visitor services or management activities.

- The special use permit would stipulate that imagery produced on refuge lands would be made available to the refuge to use in environmental education and interpretation, outreach, internal documents, or other suitable uses. In addition, any commercial products must include appropriate credits to the refuges, the Refuge System, and the Service.

- Any commercial filming, still photography, or audio recording permits that are requested must demonstrate a means to extend public appreciation and understanding of wildlife or natural habitats, or enhance education, appreciation, and understanding of the Refuge System, or facilitate outreach and education goals of the refuges.

- Still photography and audio recording also require a special use permit (with specific conditions as outlined above) if one or more of the following would occur:

  - it would occur in places where or when members of the public are not allowed.

  - it uses model(s), set(s), or prop(s) that are not part of the location's natural or cultural resources or administrative facilities.

  - the refuge would incur additional administrative costs to monitor the activity.

  - the refuge would need to provide management and oversight to avoid impairment of the resources and values of the site; limit resource damage; or minimize health and safety risks to the visiting public.

  - the photographer(s) intentionally manipulate(s) vegetation to create a "shot" (for example cutting vegetation to create a blind).

- To minimize impact on refuge lands and resources, the refuge staff would ensure that all commercial filmmakers, commercial still photographers, and commercial audio recorders comply with policies, rules, and regulations, and refuge staff would monitor and assess the activities of all filmmakers, photographers, and audio recorders.

Justification

Commercial filming, still photography, or audio recording are economic uses that must contribute to the achievement of the refuge purposes, mission of the Refuge System, or the mission of the Service. Providing opportunities for commercial filming, still photography, and audio recording that meets the above requirements should result in increased public awareness of the refuges' ecological importance as well as advancing the public's knowledge and support for the Refuge System and the Service. The stipulations outlined above and conditions imposed in the special use permits issued to commercial filmmakers, still photographers, and audio recorders would ensure that these wildlife-dependent activities occur without adverse effects on refuge resources or refuge visitors.

Mandatory 15-year reevaluation date: 2030

Prescribed Grazing and Haying

Since the three refuges were established, prescribed grazing and haying have been used to achieve a number of habitat objectives. These tools are used to improve the vigor and maintain the health of plant communities by removing decadent vegetation that has accumulated over several growing seasons, as well as reduce or eliminate infestations of noxious and invasive plants, often in combination with herbicide applications. Additionally, they are used to modify the condition of plant communities to make them more attractive to some wildlife species.

Domestic cattle (including calves and yearlings), domestic sheep, and, to a lesser degree, bison (which are classified as "livestock" by the State of Colorado) have been used on the refuges.

Haying and grazing is conducted with private cooperators through annual special use permit or cooperative farming agreements. Cooperators are charged at fair market value for the grazing or haying privilege, and the permit or agreement fee may be reduced based on project objectives.

Hay cutting is used almost entirely in wetland habitat while livestock grazing is used mostly on wetland. Livestock grazing is used in uplands to combat noxious weeds.

In all cases grazing and haying are and would be used to meet specific management objectives outlined in the permit that would be communicated to the permittee or cooperator.

Availability of Resources

Current staffing levels allow for fundamental planning and administration of grazing and haying programs, but allow only very basic monitoring of treatment efficacy. Additional staff positions are identified for the proposed alternative (table 7) to satisfy this need.

Anticipated Impacts of Use

As with the use of many vegetation management tools, there could be a negative impact for some species in the short term. For example, a temporary drop in duck nesting densities has been documented on the Monte Vista Refuge after vegetation removal in wetland habitat. This immediate decline in nesting is confined to the treatment area and is relatively short term. Although refuge staff and permittees are increasingly relying on single strand electric fencing, multi-strand barbed wire fence is still required in many instances. Improperly designed barbed wire fence presents hazards to elk, deer, pronghorn, and some bird species.

Both grazing and haying can be detrimental to riparian habitat and riparian habitat restoration projects. Steps must be taken to exclude grazing and haying from riparian areas unless they are used as part of a deliberate prescription.

The benefits of thoughtful use of haying and grazing exceed the negative impacts.

Determination

Grazing and haying are compatible uses within the refuge complex.

Stipulations Necessary To Ensure Compatibility

- Ensure control of location, duration, and intensity of grazing through carefully planned and implemented projects that are designed to achieve site-specific biological objectives. Use herders to move animals when fencing requirements are too large or impractical.
- Monitor results of grazing and haying treatments.
- Design and implement haying projects to achieve biological objectives.
- Use the appropriate class of livestock to meet project goals.
- Grazing or haying prescriptions on any individual refuge would not exceed 25 percent of the refuge in any given year.
- The refuge manager would retain control over all haying and grazing practices and has the right to discontinue any practice if conditions change that may compromise the compatibility of the project.

Justification

Prescribed livestock grazing and haying are two grassland and wetland management tools that are used in combination with rest, prescribed fire, and herbicides, and are effective in maintaining and restoring quality migratory bird habitat. They are also valuable tools in establishing vegetative structural conditions needed for the life requirements of many species, such as loafing and foraging habitat for sandhill cranes, foraging habitat for dabbling ducks and some shorebirds, and foraging and breeding habitat for Gunnison's prairie dogs. Grazing and haying practices are easily planned, controlled, implemented, and monitored. Due to the value of cattle and hay as commodities, grazing and haying are extremely cost-effective methods to treat large tracts of habitat to meet habitat objectives.

Many wetland-dependent migratory bird species (waterfowl, northern harriers, and short-eared owls in particular) require tall dense stands of grass and sedges for optimal nesting habitat. These plant communities have evolved under a regime of regular disturbance, primarily ungulate grazing and fire. Historic management practices on all three of the refuges consisted of frequent grazing or haying events that removed decadent vegetation from previous years. The Alamosa and Monte Vista Refuges saw little disturbance of vegetation during the late 1990s and early 2000s, resulting in little removal of residual vegetation. Refuge staff has observed that the overall health and vigor of these plant communities declined during this time period. The years of accumulation of vegetation seem to have reduced the stem density and height of grasses and sedges, likely from (1) shading the current year's growth and compromising photosynthesis, (2) insulating the soil and effectively retarding the initiation of spring plant growth, and (3) preventing nutrients contained in above-ground portions of the plant from reentering the soil and nutrient cycle.

Refuge staff must be able to use these tools to restore and maintain healthy plant communities in conditions that directly benefit migratory birds and other wildlife.

Mandatory 15-year reevaluation date: 2030

Cooperative Farming Program (Monte Vista Refuge)

This plan proposes to continue farming on the Monte Vista Refuge to produce an average of 190 acres of small grain (primarily barley) annually in order to provide food for spring-migrating sandhill cranes. This food production would occur on four fields, each of which would be irrigated by center pivot sprinklers. This irrigation technique is preferred due to the dramatically reduced cost (primarily for labor) and greater water efficiency compared with the flood irrigation practices that were used before 1990.

Farming operations would be conducted by a cooperating farmer under an agreement with the refuge manager. The typical agreement allows the cooperator to plant half of a field with barley and the other half with alfalfa. The four farm fields on the refuge average about 100 acres of cultivated land on each. The cooperator is responsible for costs associated with planting and irrigating (pumping), while the refuge is responsible for maintaining the associated water rights and for major maintenance to the sprinkler system and well. At the end of the growing season, the small grain crops are not harvested and are left standing. Just prior to and during spring sandhill crane migration, these standing crops are scattered to the ground by mowing them, which makes them available for the migrating cranes. The alfalfa grown on the other half of the irrigated field becomes the property of the cooperative farmer. Refuge and cooperator responsibilities may vary between fields and years in response to changing maintenance circumstances.

Availability of Resources

Because of the low costs associated with the cooperative farming approach, adequate funding exists to administer this farming program. Refuge responsibilities include maintenance of the associated water rights and maintenance of irrigation equipment. Water rights maintenance includes the ability to demonstrate beneficial use of the water and compliance with upcoming ground water rules and regulations pertaining to groundwater. Some of the systems irrigating these fields are supplemented by surface water when available. In these instances, refuge responsibilities include membership in the mutual ditch company and maintenance of the water distribution system. Maintenance of these water rights is required whether the water is used for farming, wetland irrigation, or other wildlife habitat objectives. Maintenance of the actual irrigation equipment is typically met within annual budgets. Exceptions include rare catastrophic pump, sprinkler, or even well failures. In these instances, Refuge System policy allows for adjustment of the annual agreement with the cooperator to cover these repairs.

Anticipated Impacts of Use

It is recognized that the benefits of this farming program come with tradeoffs. The benefits of this farming program include (1) assurance that the Rocky Mountain population of greater sandhill cranes arrive on breeding grounds in good physical condition, increasing the likelihood of a successful nesting effort and (2) providing a remarkable and popular wildlife viewing opportunity on the refuge. The Monte Vista Crane Festival has been conducted on the Monte Vista Refuge for 31 years and is the largest wildlife viewing event in Colorado. Large numbers of cranes feeding on one or more of these fields provides unparalleled viewing opportunities for thousands of visitors each spring.

Continuation of the farming program comes largely at the cost of using land and water for grain production instead of maintaining native wildlife habitat.

Determination

This cooperative farming program is compatible when used as a tool for the net benefit of migratory birds.

Stipulations Necessary To Ensure Compatibility

Cooperative farming would be conducted under the terms of a cooperative farming agreement. The agreement would contain general and special conditions to ensure consistency with management objectives. Some of the general stipulations include:

- The use of herbicides would be coordinated with the refuge manager and comply with the station's pesticide use plan.

- Genetically modified crops are not currently used in this farming program. Any future use of such crops would comply with Region 6 policy guidance.
- The cooperative farmer cannot begin harvesting alfalfa in the spring until after most ground-nesting bird activity is complete, as determined by the refuge manager.

Other stipulations would be considered depending upon site- and time-specific circumstances.

Justification

For centuries, the San Luis Valley has been an important migratory staging area for the Rocky Mountain population of greater sandhill cranes. During spring migration, an estimated 18,000–20,000 greater sandhill cranes and approximately 5,000–6,000 lesser and Canadian sandhill cranes inhabit the valley between late February and early April. During this period, they build up necessary energy reserves to finish migration to their nesting grounds (Tacha et al. 1987). These energy reserves also greatly influence breeding success. However, the loss of natural shallow-water wetlands, due to land use modifications and alterations to hydrology, has reduced the overall amount of potential foraging areas throughout the valley. Furthermore, it is believed that sandhill cranes did not migrate through the valley until later in the spring when natural wetlands would have been largely free of ice and more invertebrates and other natural food sources would have been available. With the advent of agricultural production of small grains in the valley over the last century, sandhill cranes began arriving as early as mid-February to take advantage of the waste grain left in agricultural fields after harvest. Sandhill cranes have likely altered the timing of their migration to take advantage of this readily available food source. They now arrive in the valley in late winter when most wetland areas are still frozen and natural food sources are largely unavailable in sufficient amounts to provide the energy required to build fat reserves. As a result, they have become dependent on small grain production in the valley.

Sandhill cranes forage for small grains in the farm fields on the Monte Vista Refuge and on private agricultural fields. In recent years, fall tillage and flood irrigation of privately owned small grain fields has become increasingly widespread in the valley. Farmers implement these practices to encourage the growth and then subsequent freezing of waste seeds to get a clean field for spring planting. In addition, since the late 1990s, the amount of acres in small grain production in the valley has been dramatically reduced because many farmers have switched to alfalfa, which is a more profitable crop. These changes in farming practices have resulted in a dramatic reduction in waste grain availability for sandhill cranes during spring and have prompted concern over whether current or future food resources are adequate to meet spring demands for migrating cranes. We would therefore continue agricultural production of a minimum of 190 acres of small grains (primarily barley) on the Monte Vista Refuge to ensure that this critical food resource is provided and available for spring staging cranes.

Mandatory 15-year reevaluation date: 2030

Research

The refuge complex occasionally receives requests to conduct research. Recent examples include projects assessing the degree of water evapotranspiration in the San Luis Valley. Priority would be given to studies that contribute to the enhancement, protection, preservation, and management of native plants, fish, wildlife populations, and habitat on the refuges. Research applicants must submit a proposal that outlines the (1) objectives of the study; (2) justification for the study; (3) detailed study methodology and schedule; and (4) potential impacts on refuge wildlife and habitat, including disturbance (short and long-term), injury, or mortality. This includes (1) a description of mitigation measures the researcher would take to reduce disturbances or impacts; (2) personnel required and their qualifications and experience; (3) status of necessary permits (such as scientific collecting permits and endangered species permits); (4) costs to refuge and refuge staff time requested, if any; and (5) product delivery schedules such as anticipated progress reports and end products such as reports or publications. Refuge staff and others, as appropriate, would review research proposals and issue special use permits if approved.

Evaluation criteria would include the following:

- Research that would contribute to specific refuge management issues would be given higher priority than the other requests.
- Research that would conflict with other ongoing research, monitoring, or management programs would not be approved.
- Research projects that can be conducted off-refuge are less likely to be approved.

- Research that causes undue disturbance or is intrusive would likely not be approved. The degree and type of disturbance would be carefully weighed when evaluating a research request.

- Research evaluation would determine if any effort has been made to minimize disturbance through study design, including adjusting location, timing, number of permittees, study methods, and number of study sites.

- Research evaluation would determine if any mitigation planning is included to minimize disturbances or impacts or to reclaim resultant disturbed areas.

- Research evaluation would determine if staffing or logistics make it impossible for the refuge to monitor researcher activity in a sensitive area.

- Specific timelines, including the length of the project and product delivery dates, would be considered and agreed upon before approval. All projects would be reviewed annually.

Availability of Resources

At current and anticipated levels, adequate funding exists to manage requests for research on the Alamosa, Baca, and Monte Vista Refuges. Administration of these requests usually includes evaluation of the proposal as well as management and monitoring of the associated special use permits. Our experience has indicated that the nominal cost of managing research projects is typically offset by the value of information acquired from the research.

Anticipated Impacts of Use

Some degree of disturbance is expected with all research activities since they often include areas of the refuges closed to or with limited public access, and some research requires collection of samples or direct handling of wildlife. However, minimal impacts on refuge wildlife and habitats is expected with research studies because special use permits would specify conditions to ensure that impacts to wildlife and habitats are kept to a minimum.

Determination

Research is a compatible use of the Alamosa, Baca, and Monte Vista Refuges.

Stipulations Necessary To Ensure Compatibility

- Extremely sensitive wildlife habitat areas and wildlife species would be provided sufficient protection from disturbance by limiting proposed research activities in these areas. All refuge rules and regulations would be strictly enforced unless otherwise exempted by refuge management.

- Refuge staff would use the criteria for evaluating a research proposal, as outlined above under “Description of Use,” when determining whether to approve a proposed study on the refuge. If proposed research methods are evaluated and determined to have potential impacts on refuge resources (habitat and wildlife), it must be demonstrated that the research is necessary for refuge resource conservation management. Measures to minimize potential impacts would need to be developed and included as part of the study design. In addition, these measures would be listed as conditions and requirements of the special use permit.

- Refuge staff would monitor research activities for compliance with conditions of the special use permit. At any time, refuge staff may accompany the researchers to determine potential impacts. Staff may determine that previously approved research and special use permits be terminated due to observed impacts. The refuge manager would also have the ability to cancel a special use permit if the researcher is out of compliance, or to ensure wildlife and habitat protection.

Justification

The program as described is determined to be compatible. Potential impacts of research activities on refuge resources would be minimized because sufficient restrictions would be included in the required special use permits and all activities would be monitored by refuge staff. At a minimum, research activities would have no significant impact on refuge resources and are expected to contribute to the enhancement, protection, preservation, and management of refuge wildlife populations and their habitats.

Mandatory 15-year reevaluation date: 2030

D.6 Approval of Compatibility Determinations

Submitted by:

____

, Project Leader Date
San Luis Valley Refuge Complex
Jackson, Wyoming

Reviewed by:

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Barbara Boyle, Refuge Supervisor Date
U.S. Fish and Wildlife Service, Region 6
National Wildlife Refuge System
Lakewood, Colorado

Approved by:

____

Will Meeks, Assistant Regional Director Date
U.S. Fish and Wildlife Service, Region 6
National Wildlife Refuge System
Lakewood, Colorado

Appendix E
Wilderness Review

This appendix summarizes our wilderness review on the refuge complex.

The purpose of a wilderness review is to identify and recommend for Congressional designation National Wildlife Refuge System (System) lands and waters that merit inclusion in the National Wilderness Preservation System. Wilderness reviews are a required element of CCPs and are conducted in accordance with the refuge planning process outlined in 602 FW 1 and 3, including public involvement and NEPA compliance.

There are three phases to the wilderness review: (1) inventory, (2) study; and (3) recommendation. Lands and waters that meet the minimum criteria for wilderness are identified in the inventory phase. These areas are called wilderness study areas (WSAs). WSAs are evaluated through the CCP process to determine their suitability for wilderness designation. In the study phase, a range of management alternatives are evaluated to determine if a WSA is suitable for wilderness designation or management under an alternate set of goals and objectives that do not involve wilderness designation. The recommendation phase consists of forwarding or reporting recommendations for wilderness designation from the Director through the Secretary and the President to Congress in a wilderness study report.

If the inventory does not identify any areas that meet the WSA criteria, we document our findings in the administrative record for the CCP which fulfills the planning requirement for a wilderness review.

Because Monte Vista Refuge has been heavily manipulated over time, we determined that no lands within the refuge even minimally met the criteria for wilderness designations, and we did not complete any further review or inventory of the refuge.

We inventoried Alamosa and Baca Refuges an subsequently found that no areas of the Alamosa Refuge met the eligibility criteria for a WSA as defined by the Wilderness Act (refer to table E1 below). However, we found two portions of the Baca Refuge along the southeastern boundary of the refuge and adjacent to the Great Sand Dunes National Park and Preserve's proposed wilderness area meet the criteria for wilderness designation (refer to tables E1 and E2 below).

E.1 Inventory Criteria

The wilderness inventory is a broad look at the planning area to identify WSAs. These are roadless areas that meet the minimum criteria for wilderness identified in Section 2(c) of the Wilderness Act as stated:

"A wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions, and which: (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological or other features of scientific, educational, scenic, or historical value."

A WSA must be a roadless area or island, meet the size criteria, appear natural, and provide outstanding opportunities for solitude or primitive recreation. The process for identification of roadless areas and application of the wilderness criteria are described in the following sections.

Identification of Roadless Areas and Roadless Islands

Identification of roadless areas and roadless islands required gathering and evaluating land status maps, land use and road inventory data, and aerial and satellite imagery for the refuges. "Roadless" refers to the absence of improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use. Only lands currently owned by the Service in fee title or BLM lands managed under a cooperative agreement were evaluated.

Roadless areas or roadless islands meet the size criteria if any one of the following standards applies:

- An area with over 5,000 contiguous acres. State and private lands are not included in making this acreage determination.
- A roadless island of any size. A roadless island is defined as an area surrounded by permanent waters or that is markedly distinguished from the surrounding lands by topographical or ecological features.
- An area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.
- An area of less than 5,000 contiguous Federal acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal wilderness managing agency such as the Forest Service, National Park Service, or Bureau of Land Management.

Evaluation of the Naturalness Criteria

In addition to being roadless, a WSA must meet the naturalness criteria. Section 2(c) defines wilderness as an area that "... generally appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable." The area must appear natural to the average visitor rather than "pristine." The presence of historic landscape conditions is not required. An area may include some human impacts provided they are substantially unnoticeable in the unit as a whole. Significant human-caused hazards, such as the presence of unexploded ordnance from military activity and the physical impacts of refuge management facilities and activities are also considered in evaluation of the naturalness criteria. An area may not be considered unnatural in appearance solely on the basis of the "sights and sounds" of human impacts and activities outside the boundary of the unit.

Evaluation of Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation

In addition to meeting the size and naturalness criteria, a WSA must provide outstanding opportunities for solitude or primitive recreation. The area does not have to possess outstanding opportunities for both solitude and primitive and unconfined recreation and does not need to have outstanding opportunities on every acre. Further, an area does not have to be open to public use and access to qualify under this criteria; Congress has designated a number of wilderness areas in the Refuge System that are closed to public access to protect resource values.

Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means non-motorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport. These primitive recreation activities may provide opportunities to experience challenge and risk, self reliance, and adventure.

These two "opportunity elements" are not well defined by the Wilderness Act but, in most cases, can be expected to occur together. An outstanding opportunity for solitude may be present in an area offering only limited primitive recreation potential. Conversely, an area may be so attractive for recreation use that experiencing solitude is not an option.

Evaluation of Supplemental Values

Supplemental values are defined by the Wilderness Act as "...ecological, geological, or other features of scientific, educational, scenic, or historic value." These values are not required for wilderness but their presence should be documented.

E.2 Inventory and Findings Alamosa Refuge

As documented below, none of the lands within Alamosa Refuge meet the criteria necessary for a WSA. Table E1 summarizes the inventory findings for each unit.

Background

Alamosa Refuge consists of 12,026 acres and was established in 1962 under authority of the Migratory Bird Treaty Act with the authorizing purpose "… for use as inviolate sanctuary or for any other management purpose, for migratory birds." Primarily located within the historic Rio Grande floodplain, the refuge encompasses lands that include 7 river miles of the Rio Grande as it transitions from flowing in a southeasterly direction to nearly directly south. This transition in direction over time has resulted in the river's taking many paths over the landscape as it changed directions. This movement of the river created an extensive system of channel sloughs, oxbow lakes, and wet meadow depressions, which make up the character of the refuge today.

Many land and water use changes have occurred throughout the San Luis Valley since European settlement. These changes revolved primarily around the expansion of agriculture and have resulted in the diminished availability of surface and ground water to the refuge. Less water available in the Rio Grande as it enters the refuge made it necessary for the development of irrigation systems to deliver water through ditches and canals to areas that historically were naturally wet. In efforts to maintain the productivity of the wetlands on the refuge over time, we have continued to make modifications by the development of even more extensive water management infrastructure (levees, ditches, and water-control structures), all of which exist on the landscape today. In addition, the landscape encompassing the refuge was changed by the construction of a BOR water salvage project that included a large, extraordinary canal that bisects the refuge. The canal, which has extensive associated support infrastructure attached to it as it passes through the refuge (heated and enclosed fish barrier screens, and a large concrete spillway and apron), was designed to deliver water to the Rio Grande below the last diversion on the river that occurs on the refuge.

For the purposes of this review, we have divided the refuge into two parcels: Parcel 1 includes those refuge lands that occur north and west of the Closed Basin Project canal, and Parcel 2 is all refuge lands south and east of the Closed Basin canal.

Table 38. Evaluation of wilderness values on Alamosa Refuge.

Refuge Area	*Areas north and west of Closed Basin canal*	*Areas south and east of Closed Basin canal*
(1) Has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; or (2) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable?	NO Area is fragmented by county roads, refuge public use roads, and several large irrigation laterals. Large water control structures and manmade dikes are evident throughout as well.	NO Area is fragmented by county roads, refuge public use roads, and several large irrigation laterals. Area is fragmented by county roads, refuge public use roads, and several large irrigation laterals. Large water control structures and man-made dikes are evident throughout as well.
(3a) Has outstanding opportunities for solitude; or (3b) has outstanding opportunities for a primitive and unconfined type of recreation?	NO (3a and 3b) (3a) Area is within 1–5 miles of the city of Alamosa with several public roads intersecting. An active railroad also bounds the unit to the north and an active regional airport is within 3 miles. (3b) Large irrigation canals limit accessibility within the units, and intersecting roads fragment and confine areas.	YES to 3a; NO to 3b (3a) Area is further from town, highways, and active railroad. (3b) Large irrigation canals limit accessibility within the units, and intersecting roads fragment and confine areas.
(4) Contains ecological, geological, or other features of scientific, educational, scenic, or historical value?	YES Area has rich diverse wetlands and riparian areas that provide scientific, educational, and scenic value	YES Area has rich diverse wetlands and riparian areas that provide scientific, educational, and scenic value.
Unit qualifies as a wilderness study area (meets criteria 1, 2, and 3a or 3b)?	NO The human imprint on the environment is substantially noticeable and unavoidable	NO The human imprint on the environment is substantially noticeable and unavoidable.

Roadless Areas, Roadless Islands, and Size Criteria

Parcels 1 and 2: Many of the roads are associated with the intensive irrigation infrastructure necessary for maintaining the refuge's productivity to meet its intended purpose. These roads divide the refuge into several smaller parcels, which are classified as management units. None of the fragmented parcels are larger than 5,000 acres.

Naturalness Criteria

Parcels 1 and 2: The land within Alamosa Refuge has been extensively altered by the construction of a vast irrigation network that allowed it to be intensively managed for hay and cattle production prior to the establishment of the refuge and ensured the productivity of its wetlands as a refuge. As a result, many of the visual qualities associated with those uses are evident on the landscape. Man-made ditches, levees, fences, roads and other infrastructure are evidence of some of the former and current operations, thus detracting from the naturalness of the refuge.

Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation

Parcel 1: There are limited opportunities for solitude or primitive and unconfined recreation in this area as it is closer to the town of Alamosa, an active regional airport, and a busy railway switchyard. Sights and sounds from the town, airport, and switchyard as well as from county roads, refuge headquarters and shop areas, and neighboring agricultural operations interfere with opportunities for solitude and unconfined recreation.

Parcel 2: This area, which is situated east and south of the Closed Basin Project canal, is located further than Parcel 1 from the influence of a neighboring hub community with facilities such as an airport, railyards, and highways. It offers opportunities for relative solitude and unconfined recreation. Neighboring operations and the low hum of a distant town can nearly always be heard, although at a much lower level than the more northern and western parcel areas.

Supplemental Values

Alamosa Refuge consists of over 12,000 acres of productive and diverse habitats flanked on the west by the Rio Grande and on the east by a large bluff escarpment providing an overlook of the entire refuge. A mosaic of seasonal to permanent wetlands and alkaline desert uplands provide for a diverse assemblage of wildlife. The juxtaposition of the bluff escarpment with nearby wetlands provided an important lookout for countless generations of hunters and as a result contains the rich archeological history of over 8,000 years of use by humans.

Although the refuge is surrounded by activities ranging from the city of Alamosa to several agricultural operations and a rail switchyard, portions still offer excellent relief from this nearby urban setting. In addition, relatively dark night skies are abundant on the southern portions of the refuge.

E.3 Inventory and Findings for Baca Refuge

As documented below, there are two areas within Baca Refuge that meet the criteria necessary for a WSA. Figure E1 shows these areas, and table E2 summarizes the inventory findings for each of the refuge's seven major management areas.

Background

The Baca Refuge located in the northeastern portion of the San Luis Valley in south-central Colorado currently contains roughly 85,942 acres of the nearly 92,500 acres authorized by Congress in 2000 as part of the Great Sand Dunes National Park and Preserve Act. The intended purpose of the refuge is to restore, enhance, and maintain wetland, upland, riparian, and other habitats for wildlife, plants, and fish that are native to the San Luis Valley. Refuge policies emphasize migratory bird conservation and consideration of the refuge in the context of broader San Luis Valley conservation efforts.

The refuge, although located at the base of the impressive Sangre de Cristo Mountains and receiving most of the runoff from the tallest portions of this steep mountain chain, is part of a closed basin having no natural surface outlet connecting it to the Rio Grande, which is the primary artery transferring water out of the San Luis Valley. Lands encompassing the refuge include the major confluence of all

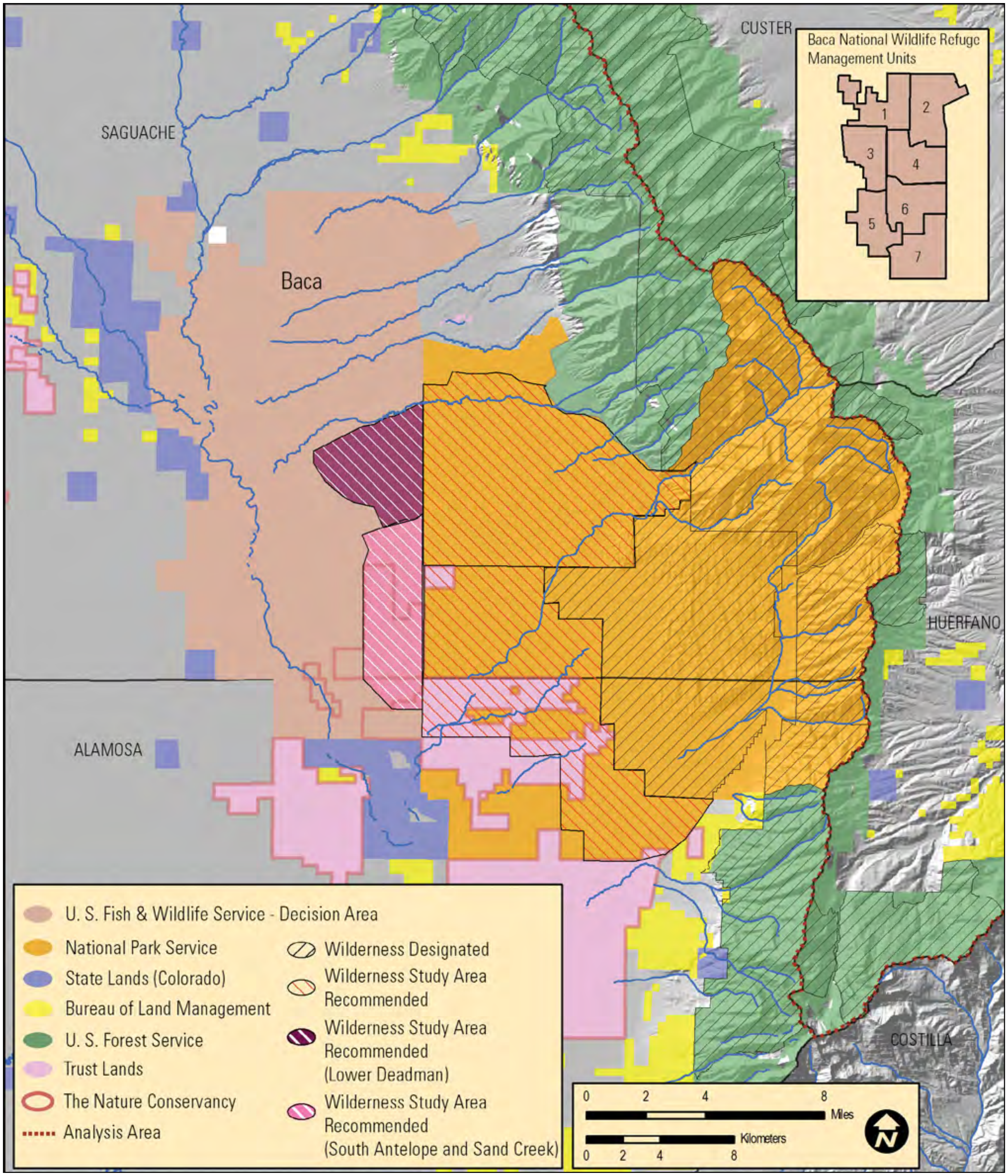

Figure 53. Wilderness Inventory for Baca Refuge.

surface waters draining into the northern portions of the valley from several creeks that originate in the Sangre de Cristo Mountains and discharge into San Luis Creek, and from Saguache and La Garita creeks, which originate in the San Juan Mountains and also discharge into San Luis Creek. Historically, water from these sources maintained one of the largest playa wetland complexes in the San Luis Valley. Restoration of this wetland complex is an emphasis for the Service.

The Baca Refuge contains a large portion of the regionally unique eolian sand sheet associated with the Great Sand Dunes complex, which features the tallest dunes in North America and one of the most fragile and complex dune systems in the world. The portions of this dune system on the on the refuge contain many unique sand ramps and stabilizing dunes, which lead to and eventually become part of the larger dune mass. These areas provide tremendously scenic settings, which include the massive dunes surrounded by alpine peaks. In addition, portions of the refuge contain remnants of some of the oldest known archaeology in the San Luis Valley (12,000 years of human history in the San Luis Valley).

The majority of the refuge area receiving surface water was developed as part of the historic Baca Grant Ranch. This ranch remained in continuous operation under different ownerships from the late 1800s until the land was acquired by the Service and the refuge was established. An intensive historic network of canals and ditches carry water from streams and wells to meadows that were historically irrigated for the production of forage for large cattle operations that existed there for nearly 120 years. The refuge continues to maintain and operate this infrastructure to provide quality wetland habitats in support of the Service mission and the refuge's intended purposes.

The Baca Refuge borders lands owned by TNC, NPS, CPW and the Colorado State Land Board. The complex of lands within these ownerships including the refuge, total more than 500,000 acres of contiguous protected land and include the Great Sand Dunes National Park and Preserve, TNC's Medano Ranch Preserve, and the San Luis Lakes State Wildlife Area. Management of these lands is primarily focused on protecting the region's hydrology, as well as the ecological, cultural, and wildlife resources of the area.

BOR operates a ground water "salvage" project within the valley's Closed Basin, including major portions of the refuge. This project extracts shallow ground water from the closed basin portion of the valley and delivers it to the Rio Grande through a 42-mile-long canal originating on the western boundary of the refuge. About one-third of this project's wells are within the boundaries of the Baca Refuge. This array of wells and a vast amount of infrastructure (well sites, pipelines, and an extensive array of powerlines and roads) dissect the majority of the western portions of the refuge.

The northeastern portion of the refuge is bounded by a 15,000-plus-acre subdivision with over 4,000 platted buildable lots and over 600 full-time residents. The landbase for this subdivision was carved from within the boundaries of the historic Baca Grant in the early 1970s. In addition, the subsurface mineral, and oil and gas rights were severed from those portions of the refuge that were part of the historic Baca Grant.

Roadless Areas, Roadless Islands, and Size Criteria (figure E-1)

Management Areas 1 and 2: These areas of the refuge contain a series of refuge-maintained roads that are used frequently in the maintenance and operation of the refuge's intensive irrigation infrastructure. In addition, these roads are heavily used by contractors and permittees assisting the Service in maintaining the refuge's productivity to meet its intended purpose. Three of the four CCP public use alternatives consider development of an auto tour route in these areas. These areas of the refuge contain a greater diversity of habitats of relatively smaller patch size and numerous fences delineating individual management units. Management Areas 3 and 5: These areas in the heart of the Closed Basin sump area contain a vast network of roads, powerlines, wells, and pipelines that comprise nearly one-third of BOR's Closed Basin Project. This extensive infrastructure greatly fragments these areas. Management Areas 4, 6, and 7: Western portions of these units are fragmented by the extensive BOR's infrastructure or the refuge's irrigation infrastructure and its associated roads. The eastern portions of these areas, which contribute to the large sand sheet associated with the great sand dunes complex, exhibit very few roads, fences, and other infrastructure that fragment many other areas of the refuge. This largely roadless area encompasses over 13,800 acres and is bounded on the east by Great Sand Dunes National Park lands that are also proposed as wilderness.

Naturalness Criteria

Management Areas 1 and 2: These lands within the Baca Refuge have primarily been shaped by the rich ranching history that has dominated this landscape for the last 120 years. The majority of the refuge irrigation water rights were secured in the late 1870s, and irrigation and associated infrastructure have continued to develop since then. Even though this presence of man's hand is so readily apparent on the landscape, there is still a feel of naturalness as the rich ranch management history that is predominate in the northern San Luis Valley results in wet meadows of native species that are uncharacteristically large and scenic.

Management Areas 3 and 5: Although these areas of the refuge contain remnants of what once was one of Colorado's largest playa wetland complexes, several decades of over demand on the area's limited water resources has resulted in little water currently reaching the area. It is in these areas where BOR's Closed Basin Project extracts shallow ground water for delivery to the Rio Grande. This water salvage project contains a vast network of roads, powerlines, wells, and pipelines that compromise every aspect of the naturalness of these areas. Management Areas 4, 6, and 7: The western portions of land within these management areas contain much of the same infrastructure for BOR's Closed Basin Project or infrastructure used by the Service for irrigation of refuge habitats. These anomalies to the natural landscape greatly detract from the overall naturalness of the area. The eastern portions of these areas, despite having been used for cattle operations for over a century, have retained their natural characteristics. Mostly roadless and intact, these areas have very few infrastructure developments. The developments that do exist consist of two cross fences, a handful of stock and monitoring wells, and three roads transecting the area, which consists of more than 13,800 acres.

Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation

Management Areas 1 and 2: These areas are on the north end of the refuge and are bounded on the north by Saguache County Road T, which serves as the only ingress/egress for the town of Crestone and the Baca Grande Subdivision. In addition, these areas house both the refuge headquarters and shop compounds. Many of the habitats in these areas are irrigated and as such have the related infrastructure. Management units within these areas are, for the most part, smaller which results in more fencing and roads on the overall landscape. All of these factors combined reduce the potential for solitude or primitive and unconfined recreation.

Management Areas 3 and 5: These areas in the heart of the Closed Basin sump contain a vast network of roads, powerlines, wells, and pipelines that comprise nearly one-third of BOR's Closed Basin Project. This extensive infrastructure requires frequent maintenance, resulting in frequent vehicle and equipment use. In addition, Colorado Highway 17 lies within 4 miles of any point in these areas. The noises, visual distractions, and the fragmentation due to the vast infrastructure limit any opportunities for solitude and unconfined recreation in these areas.

Management Areas 4, 6, and 7: Western portions of these units are fragmented by BOR's infrastructure and the refuge's irrigation infrastructure and its associated roads and offer little opportunity for solitude and unconfined recreation, while the eastern portions are located nearly as far as one can get from regular human activity on the valley floor. These eastern areas share an administrative boundary with NPS proposed wilderness associated with the Great Sand Dunes National Park and Preserve. NPS has documented a portion of Great Sand Dunes National Park and Preserve as being one the quietest places in the National Park System. One of the greatest attributes of these areas is the opportunity they provide for solitude and unconfinement. With or without a wilderness designation, we would strive to maintain those characteristics in these areas.

Supplemental Values

Management Areas 1 and 2: These areas of the refuge, although altered by the imprint of man, contain many important values, such as remnants of the rich history of the Baca Grant Ranch and many important archeological sites containing artifacts of more than 9,000 years of human existence in and around important wetlands. Habitats in these management areas consist primarily of rabbit-brush–dominated uplands and large expanses of irrigated wet meadows. The juxtaposition of these two habitats is of interest to scientists as they continue to gather information on their importance and role in overall San Luis Valley wetlands conservation.

Although these areas do not offer opportunities for roadlessness or solitude, they are situated within 10 miles of five 14,000 plus foot peaks and offer a fantastic and rare vantage of the impressive mountain range containing them. Because of the extreme private nature of the ranch for over the past century, the area has been viewed and enjoyed by only a few individuals. Many life-long neighbors who have visited these areas have commented on how this place gives them an incredible and wonderfully different vantage of the area they call their own and where they have spent their whole lives.

Management Areas 3 and 5: These areas in the heart of the Closed Basin sump once contained one of the largest playa wetland complexes in the San Luis Valley, and although they no longer receive large amounts of water and have been fragmented and invaded by man, there are portions that occasionally can be wetted. These areas offer small glimpses of what once likely dominated the landscape. The resulting natural wetlands that occur are of extreme importance to the scientific community. In addition, the overall area contains a rich archaeological and paleontological history.

Management Areas 4, 6, and 7: Western portions of these areas are similar to the areas described above for management areas 3 and 5. The eastern portions have experienced very little intervention by man and are largely unfragmented and intact. Situated on the sand sheet associated with the rare and globally significant Great Sand Dunes complex, they contain unique native habitats and species. Night skies, extreme quietness, and incredible vistas dominate the area and offer a unique insight as to what the valley floor may have been like prior to human settlement.

Table 39. Evaluation of wilderness values on Baca Refuge.

Refuge Unit or Area	*Management Areas 1 and 2*	*Management Areas 3 and 5*	*Management Areas 4, 6 and 7 (Western Portions)*	*Management Areas 4, 6, and 7 (Eastern Portions)*
(1) Has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; or (2) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable.	NO Area is fragmented by roads, fences, irrigation laterals, large water control structures, administrative sites, corrals, and sheds.	NO Area extremely fragmented by BOR's roads, pipelines and a large industrial-like canal which are readily visible. Overhead powerline webs landscape and can be seen for miles.	NO Area extremely fragmented by BOR's roads, powerlines, pipelines, and a large industrial-like canal, which are readily visible. Overhead powerlines landscape and can be seen for miles.	YES Areas mostly intact with very few intervening roads and infrastructure and little sign of intervention by man.
(3a) Has outstanding opportunities for solitude; or (3b) Has outstanding opportunities for a primitive and unconfined type of recreation.	NO (3a) Management areas are bounded on the north by busy county road. In addition, these areas house several administrative sites. All major refuge access points are through these areas. (3b) Area is fragmented by roads, several large irrigation laterals, large water control structures, corrals, and sheds. Smaller management units result in more confinement.	NO Area extremely fragmented by BOR's roads, powerlines, pipelines and a large industrial-like canal	NO Area extremely fragmented by BOR's roads, powerlines, pipelines, and a large industrial-like canal.	YES Areas not easily accessible and located nearly as far from regular human activity as possible on the valley floor; share boundary with current WSA.
(5) Contains ecological, geological, or other features of scientific, educational, scenic, or historical value?	YES Area has rich diverse wetland, riparian, and upland habitats. Provides scientific, educational and scenic value. Contains rich historic and prehistoric values.	YES Area has rich playa habitats which provide scientific, educational and scenic value. Also, contains rich prehistoric values.	YES Area has rich playa habitats that provide scientific, educational, and scenic value. Also, contains rich prehistoric values.	YES Areas associated with rare and globally significant Great Sand Dunes complex. Contains unique native habitats and rich historic and prehistoric values.
Unit qualifies as a wilderness study area (meets criteria 1, 2, and 3a or 3b)?	NO The human imprint on the environment is substantially noticeable and unavoidable	NO The human imprint on the environment is substantially noticeable and unavoidable	NO The human imprint on the environment is substantially noticeable and unavoidable	YES

Appendix F
Species Lists

	Common Name	*Scientific Name*
	Birds ✧ Known to nest on complex > Suspected to nest on complex < Rare or accidental sightings	
	Loons	
<	Pacific loon	*Gavia pacifica*
<	Common loon	*Gavia immer*
	Grebes	
✧	Pied-billed grebe	*Podilymbus podiceps*
✧	Eared grebe	*Podiceps nigricollis*
>	Western grebe	*Aechmophorus occidentalis*
	Clark's grebe	*Aechmophorus clarkii*
	Pelicans	
	American white pelican	*Pelecanus erythrorhynchos*
	Cormorants	
	Double-crested cormorant	*Phalacrocorax auritus*
	Bitterns, Herons, and Egrets	
✧	American bittern	*Botaurus lentiginosus*
<	Least bittern	*Ixobrychus exilis*
	Great blue heron	*Ardea herodias*
	Great egret	*Ardea alba*
✧	Snowy egret	*Egretta thula*
	Little blue heron	*Egretta caerulea*
✧	Cattle egret	*Bubulcus ibis*
	Green heron	*Butorides virescens*
✧	Black-crowned night-heron	*Nycticorax nycticorax*
<	Tricolored heron	*Egretta tricolor*
	Ibises and Spoonbills	
✧	White-faced ibis	*Plegadis chihi*
<	White ibis	*Eudocimus albus*
	New World Vultures	
	Turkey vulture	*Cathartes aura*
	Swans, Geese, and Ducks	
	Greater white-fronted goose	*Anser albifrons*
	Snow goose	*Chen caerulescens*
	Ross' goose	*Chen rossii*
✧	Canada goose	*Branta canadensis*
	Tundra swan	*Cygnus columbianus*
	Wood duck	*Aix sponsa*
✧	Gadwall	*Anas strepera*
✧	American wigeon	*Anas americana*
✧	Mallard	*Anas platyrhynchos*
✧	Blue-winged teal	*Anas discors*
✧	Cinnamon teal	*Anas cyanoptera*
✧	Northern shoveler	*Anas clypeata*
✧	Northern pintail	*Anas acuta*
✧	Green-winged teal	*Anas crecca*
	Canvasback	*Aythya valisineria*
✧	Redhead	*Aythya americana*
	Ring-necked duck	*Aythya collaris*
	Greater scaup	*Aythya marila*
	Lesser scaup	*Aythya affinis*
	Bufflehead	*Bucephala albeola*
	Common goldeneye	*Bucephala clangula*
	Common merganser	*Mergus merganser*
<	Hooded merganser	*Lophodytes cucullatus*
<	Red-breasted merganser	*Mergus serrator*
✧	Ruddy duck	*Oxyura jamaicensis*
	Osprey, Kites, Hawks, and Eagles	
	Osprey	*Pandion haliaetus*
	Bald eagle	*Haliaeetus leucocephalus*
✧	Northern harrier	*Circus cyaneus*
	Sharp-shinned hawk	*Accipiter striatus*
	Cooper's hawk	*Accipiter cooperii*
<	Northern goshawk	*Accipiter gentilis*
✧	Swainson's hawk	*Buteo swainsoni*
✧	Red-tailed hawk	*Buteo jamaicensis*
	Ferruginous hawk	*Buteo regalis*
	Rough-legged hawk	*Buteo lagopus*
	Golden eagle	*Aquila chrysaetos*

	Common Name	*Scientific Name*
	Gallinaceous Birds	
✧	Ring-necked pheasant (Introduced)	*Phasianus colchicus*
	Rails	
✧	Virginia rail	*Rallus limicola*
✧	Sora	*Porzana carolina*
✧	American coot	*Fulica americana*
<	Purple gallinule	*Porphyrio martinicus*
<	Common gallinule	*Gallinula galeata*
	Cranes	
	Sandhill crane	*Grus canadensis*
	Plovers	
	Black-bellied plover	*Pluvialis squatarola*
	Semipalmated plover	*Charadrius semipalmatus*
✧	Killdeer	*Charadrius vociferus*
	Mountain plover	*Charadrius montanus*
<	Snowy plover	*Charadrius nivosus*
	Stilts and Avocets	
✧	Black-necked stilt	*Himantopus mexicanus*
✧	American avocet	*Recurvirostra americana*
	Sandpipers and Phalaropes	
	Greater yellowlegs	*Tringa melanoleuca*
	Lesser yellowlegs	*Tringa flavipes*
	Solitary sandpiper	*Tringa solitaria*
	Willet	*Catoptrophorus semipalmatus*
✧	Spotted sandpiper	*Actitis macularia*
<	Whimbrel	*Numenius phaeopus*
	Long-billed curlew	*Numenius americanus*
	Marbled godwit	*Limosa fedoa*
	Sanderling	*Calidris alba*
	Western sandpiper	*Calidris mauri*
	Least sandpiper	*Calidris minutilla*
	Baird's sandpiper	*Calidris bairdii*
	Pectoral sandpiper	*Calidris melanotos*
	Stilt sandpiper	*Calidris himantopus*
	Long-billed dowitcher	*Limnodromus scolopaceus*
✧	Wilson's snipe	*Gallinago delicata*
✧	Wilson's phalarope	*Phalaropus tricolor*
	Skuas, Jaegers, Gulls, and Terns	
	Franklin's gull	*Larus pipixcan*
	Bonaparte's gull	*Larus philadelphia*
	Ring-billed gull	*Larus delawarensis*

	Common Name	*Scientific Name*
<	Caspian tern	*Hydroprogne caspia*
<	Common tern	*Sterna hirundo*
<	Least tern	*Sternula antillarum*
	Forster's tern	*Sterna forsteri*
>	Black tern	*Chlidonias niger*
	Pigeons and Doves	
✧	Rock Dove (Introduced)	*Columba livia*
	Band-tailed pigeon	*Columba fasciata*
✧	Mourning dove	*Zenaida macroura*
	Eurasian collared-dove (Introduced)	*Streptopelia decaocto*
	Barn Owls	
	Barn owl	*Tyto alba*
	Typical Owls	
✧	Great horned owl	*Bubo virginianus*
>	Burrowing owl	*Athene cunicularia*
	Long-eared owl	*Asio otus*
✧	Short-eared owl	*Asio flammeus*
	Nightjars	
>	Common nighthawk	*Chordeiles minor*
	Common poorwill	*Phalaenoptilus nuttallii*
	Swifts	
	White-throated swift	*Aeronautes saxatalis*
	Hummingbirds	
	Black-chinned hummingbird	*Archilochus alexandri*
	Broad-tailed hummingbird	*Selasphorus platycercus*
	Rufous hummingbird	*Selasphorus rufus*
	Calliope hummingbird	*Stellula calliope*
	Kingfishers	
>	Belted kingfisher	*Ceryle alcyon*
	Woodpeckers	
	Lewis' woodpecker	*Melanerpes lewis*
	Williamson's sapsucker	*Sphyrapicus thyroideus*
	Red-naped sapsucker	*Sphyrapicus nuchalis*
	Downy woodpecker	*Picoides pubescens*
	Hairy woodpecker	*Picoides villosus*
	Northern flicker	*Colaptes auratus*
<	Red-headed woodpecker	*Melanerpes erythrocephalus*
	Falcons and Caracaras	
✧	American kestrel	*Falco sparverius*

	Common Name	Scientific Name
	Merlin	*Falco columbarius*
	Peregrine falcon	*Falco peregrinus*
	Prairie falcon	*Falco mexicanus*
	Tyrant Flycatchers	
	Olive-sided flycatcher	*Contopus cooperi*
✧	Western wood-pewee	*Contopus sordidulus*
✧	Willow flycatcher	*Empidonax traillii*
✧	Southwestern willow flycatcher	*Empidonax traillii extimus*
✧	Say's phoebe	Sayornis saya
<	Vermillion flycatcher	*Pyrocephalus rubinus*
	Gray flycatcher	*Empidonax wrightii*
	Cassin's kingbird	*Tyrannus vociferans*
>	Western kingbird	*Tyrannus verticalis*
	Eastern kingbird	*Tyrannus tyrannus*
	Shrikes	
✧	Loggerhead shrike	*Lanius ludovicianus*
	Northern shrike	*Lanius excubitor*
	Vireos	
	Warbling vireo	*Vireo gilvus*
	Crows, Jays, and Magpies	
✧	Black-billed magpie	*Pica hudsonia*
	American crow	*Corvus brachyrhynchos*
	Common raven	*Corvus corax*
	Pinyon jay	*Gymnorhinus cyanocephalus*
	Larks	
✧	Horned lark	*Eremophila alpestris*
	Swallows	
✧	Tree swallow	*Tachycineta bicolor*
	Violet-green swallow	*Tachycineta thalassina*
>	Northern rough-winged swallow	*Stelgidopteryx serripennis*
<	Purple martin	*Progne subis*
	Bank swallow	*Riparia riparia*
✧	Cliff swallow	*Petrochelidon pyrrhonota*
✧	Barn swallow	*Hirundo rustica*
	Titmice and Chickadees	
	Black-capped chickadee	*Poecile atricapilla*
	Mountain chickadee	*Poecile gambeli*
	Nuthatches	
	White-breasted nuthatch	*Sitta carolinensis*

	Common Name	Scientific Name
	Wrens	
	Rock wren	*Salpinctes obsoletus*
✧	House wren	*Troglodytes aedon*
✧	Marsh wren	*Cistothorus palustris*
	Kinglets	
	Ruby-crowned kinglet	*Regulus calendula*
	Thrushes	
	Western bluebird	*Sialia mexicana*
	Mountain bluebird	*Sialia currucoides*
	Swainson's thrush	*Catharus ustulatus*
✧	American robin	*Turdus migratorius*
	Mimic Thrushes	
	Northern mockingbird	*Mimus polyglottos*
✧	Sage thrasher	*Oreoscoptes montanus*
<	Brown thrasher	*Toxostoma rufum*
	Gray catbird	*Dumetella carolinensis*
	Starlings	
✧	European starling (Introduced)	*Sturnus vulgaris*
	Wagtails and Pipits	
	American pipit	*Anthus rubescens*
	Wood Warblers	
✧	Yellow warbler	*Dendroica petechia*
	Yellow-rumped warbler	*Dendroica coronata*
	Townsend's warbler	*Dendroica townsendi*
	Northern waterthrush	*Seiurus noveboracensis*
	MacGillivray's warbler	*Oporornis tolmiei*
✧	Common yellowthroat	*Geothlypis trichas*
	Wilson's warbler	*Wilsonia pusilla*
<	Orange-crowned warbler	*Oreothlypis celata*
<	Black-and-white warbler	*Mniotilta varia*
<	Prothonotary warbler	*Protonotaria citrea*
<	Hooded warbler	*Setophaga citrina*
	Tanagers	
	Western tanager	*Piranga ludoviciana*
	Sparrows and Towhees	
	Green-tailed towhee	*Pipilo chlorurus*
	Spotted towhee	*Pipilo maculatus*
	Cassin's sparrow	*Aimophila cassinii*

	Common Name	Scientific Name
	American tree sparrow	*Spizella arborea*
	Chipping sparrow	*Spizella passerina*
✧	Brewer's sparrow	*Spizella breweri*
✧	Vesper sparrow	*Pooecetes gramineus*
	Lark sparrow	*Chondestes grammacus*
	Black-throated sparrow	*Amphispiza bilineata*
	Lincoln's sparrow	*Melospiza lincolnii*
	Sage sparrow	*Amphispiza belli*
	Lark bunting	*Calamospiza melanocorys*
✧	Savannah sparrow	*Passerculus sandwichensis*
	Grasshopper sparrow	*Ammodramus savannarum*
✧	Song sparrow	*Melospiza melodia*
✧	White-crowned sparrow	*Zonotrichia leucophrys*
<	Swamp sparrow	*Melospiza georgiana*
	Dark-eyed junco	*Junco hyemalis*
<	Lapland longspur	*Calcarius lapponicus*
	Cardinals, Grosbeaks, and Allies	
	Black-headed grosbeak	*Pheucticus melanocephalus*
	Blue grosbeak	*Guiraca caerulea*
<	Indigo bunting	*Passerina cyanea*
	Blackbirds and Orioles	
	Bobolink	*Dolichonyx oryzivorus*
✧	Red-winged blackbird	*Agelaius phoeniceus*
✧	Western meadowlark	*Surnella neglecta*
✧	Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
✧	Brewer's blackbird	*Euphagus cyanocephalus*
	Great-tailed grackle	*Quiscalus mexicanus*
✧	Brown-headed cowbird	*Molothrus ater*
✧	Bullock's oriole	*Icterus bullockii*
<	Orchard oriole	*Icterus spurius*
	Finches	
	Gray-crowned rosy-finch	*Leucosticte tephrocotis*
	Cassin's finch	*Carpodacus cassinii*
✧	House finch	*Carpodacus mexicanus*
	Pine siskin	*Carduelis pinus*
	Lesser goldfinch	*Carduelis psaltria*
>	American goldfinch	*Carduelis tristis*
	Old World Sparrows	
	House sparrow (Introduced)	*Passer domesticus*
	Mammals ✧ Breeding species on complex	
	Insectivores	
✧	Masked shrew	*Sorex cinereus*
✧	Montane shrew	*Sorex monticolus*
✧	Water shrew	*Sorex palustris*
	Bats	
	Western small-footed myotis	*Myotis ciliolabrum*
	Long-eared myotis	*Myotis evotis*
	Little brown myotis	*Myotis lucifugus*
	Yuma myotis	*Myotis yumanensis*
	Hoary bat	*Lasiurus cinereus*
	Silver-haired bat	*Lasionycteris noctivagans*
	Big brown bat	*Eptesicus fuscus*
	Townsend's big-eared bat	*Plecotus townsendii*
	Brazilian free-tailed bat	*Tadarida brasiliensis*
	Lagomorphs	
✧	Desert cottontail	*Sylvilgus audubonii*
✧	Mountain cottontail	*Sylvilagus nuttallii*
✧	White-tailed jackrabbit	*Lepus townsendii*
	Rodents	
✧	Least chipmunk	*Tamias minimus*
	Yellow-bellied marmot	*Marmota flaviventris*
✧	Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*
	Wyoming ground squirrel	*Urocitellus elegans*
	Gunnison's prairie dog	*Cynomys gunnisoni*
✧	Botta's pocket gopher	*Thomomys bottae*
✧	Northern pocket gopher	*Thomomys talpoides*
✧	Plains pocket mouse	*Perognathus flavescens*
✧	Silky pocket mouse	*Perognathus flavus*
✧	Ord's kangaroo rat	*Dipodimys ordii*
✧	Western harvest mouse	*Reithrodontomys megalotis*
✧	Deer mouse	*Peromyscus maniculatis*

	Common Name	Scientific Name
✧	Northern grasshopper mouse	*Onychomys leucogaster*
✧	House mouse	*Mus musculus*
✧	Western jumping mouse	*Zapus princeps*
✧	Long-tailed vole	*Microtus longicaudus*
✧	Montane vole	*Microtus montanus*
✧	Meadow vole	*Mecrotus pennsylvanicus*
✧	Muskrat	*Ondatra zibethicus*
✧	American beaver	*Castor canadensis*
✧	Common porcupine	*Erithizon dorsatum*
	Carnivores	
✧	Coyote	*Canis latrans*
✧	Red fox	*Vulpes vulpes*
	Gray fox	*Urocyon cinereoargenteus*
	Black bear	*Ursus americanus*
✧	Common raccoon	*Procyon lotor*
	Short-tailed weasel	*Mustela erminea*
✧	Long-tailed weasel	*Mustela frenata*
	Mink	*Mustela vison*
✧	American badger	*Taxidea taxus*
	Western spotted skunk	*Spilogale gracilus*
✧	Striped skunk	*Mephitis mephitus*
	Mountain lion	*Felis concolor*
	Bobcat	*Lynx rufus*
	Ungulates	
✧	American elk	*Cervus elaphus*
✧	Mule deer	*Odocoileus hemionus*
	White-tailed deer	*Odocoileus virginianus*
	Pronghorn	*Antilocapra Americana*
	Reptiles	
	Snapping turtle	*Chelydra serpentia*
	Short-horned lizard	*Phrynosoma douglassii*
	Eastern fence lizard	*Sceloporous undulatus*
	Variable skink	*Eumeces gaigeae*
	Milk snake	*Lampropeltis triangulum*
	Bullsnake	*Pituophis melnoleucus*
	Western terrestrial garter snake	*Thamnophis elegans*
	Common garter snake	*Thamnophis sirtalis*
	Western rattlesnake	*Crotalus viridis*
	Smooth green snake	*Opheodrys vernalis*
	Amphibians	
	Tiger salamander	*Ambystoma tigrinum*

Common Name	Scientific Name
Plains spadefoot	*Scaphiopus bombifrons*
Western toad	*Bufo boreas*
Great Plains toad	*Bufo cognatus*
Woodhouse's toad	*Bufo woodhousii*
Western chorus frog	*Pseudacris triseriata*
Bullfrog	*Rana catesbeiana*
Northern leopard frog	*Rana pipiens*
Fish	
Northern pike	*Esox lucius*
Brown trout	*Salmo trutta*
Black bullhead	*Ameiurus melas*
Rio Grande sucker	*Catostomus plebeius*
Rio Grande chub	*Gila pandora*
Fathead minnow	*Pimephales promelas*
Longnose dace	*Rhinichthys cataractae*
White sucker	*Catostomus commersonii*
Common carp	*Cyprinus carpio*
Tench	*Tinca tinca*
Vegetation	
Agavaceae	
Yucca	*Yucca* spp.
Aizoaceae	
Verrucose seapurslane	*Sesuvium verruosum*
Alismataceae	
Arrowhead	*Sagittaria cuneata*
Northern water plantain	*Alisma* cf.
Alsinaceae	
Longleaf starwort	*Stellaria longifolia*
Alliaceae	
Wild onion/garlic	*Allium* spp.
Amaranthaceae	
Rough pigweed	*Amaranthus retroflexus*
Mat amaranth	*Amaranthus blitoides*
Anacardiaceae	
Skunkbush sumac	*Rhus aromatica*
Apiaceae	
Rocky Mountain hemlock-parsley	*Conioselinum scopulorum*
Common cowparsnip	*Heracleum sphondylium*
Hemlock waterparsnip	*Sium suave*
Asclepiadaceae	
Showy milkweed	*Asclepias speciosa*
Swamp milkweed	*Asclepias incarnata*

Common Name	Scientific Name
Asparagaceae	
Garden asparagus-fern	*Asparagus officinalis*
Starry false lily of the valley	*Maianthemum stellatum*
Asteraceae	
Aster species	*Aster* spp.
Canada thistle	*Cirsium arvense*
Common cocklelbur	*Xanthium strumarium*
Common mare's-tail	*Hippuris vulgaris*
Common sagewort	*Artemesia campestris*
Dandelion	*Taraxacum officinale*
Fringed sage	*Artemisia frigida*
Horseweed	*Conyza canadensis*
Marsh sowthistle	*Sonchus arvensis*
Povertyweed	*Iva axillaris*
Rabbitbrush	*Chrysothamnus nauseosus*
Russian knapweed	*Acroptilon repens*
Silver sage	*Artemesia cana*
Snakeweed	*Gutierrezia lucida*
Sunflower	*Helianthus* spp.
Wild lettuce	*Lactuca serriola*
Yarrow	*Achillea millefolium*
Common yarrow	*Achillea lanulosa*
Pale agoseris	*Agoseris glauca*
Alkali marsh aster	*Almutaster pauciflorus*
Flatspine bur ragweed	*Ambrosia acanthicarpa*
Littleleaf pussytoes	*Antennaria microphylla*
Lesser burdock	*Arctium minus*
Bienniel wormwood	*Artemisia biennis*
Prairie sagewort	*Artemisia frigida*
White sagebrush	*Artemisia ludoviciana*
Nodding beggarticks	*Bidens cernua*
Slimlobe beggarticks	*Bidens tenuisecta*
Rubber rabbitbrush	*Chrysothamnus nauseosus*
Prairie thistle	*Cirsium canescens*
Parry's thistle	*Cirsium parryi*
Purple aster	*Dieteria biglovii*
Running fleabane	*Erigeron divergens*
Trailing fleabane	*Erigeron flagellaris*
Beautiful fleabane	*Erigeron formosissimus*
Streamside fleabane	*Erigeron glabellus*
White sagebrush	*Artemisia ludoviciana*
Nodding beggarticks	*Bidens cernua*
Slimlobe beggarticks	*Bidens tenuisecta*
Rubber rabbitbrush	*Chrysothamnus nauseosus*
Prairie thistle	*Cirsium canescens*
Parry's thistle	*Cirsium parryi*
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Beautiful fleabane	*Erigeron formosissimus*
Streamside fleabane	*Erigeron glabellus*
Western marsh cudweed	*Gnaphalium palustre*
Marsh cudweed	*Gnaphalium uliginosum*
Hairy false goldenaster	*Heterotheca villosa*
Fineleaf hymenopappus	*Hymenopappus filifolius*
Blue lettuce	*Lactuca tatarica*
Hall's ragwort	*Ligularia bigelovii*
Rush skeletonplant	*Lygodesmia juncea*
Fall tansyaster	*Machaeranthera canescens*
Smallflower tansyaster	*Machaeranthera parviflora*
Tanseyleaf tansyaster	*Machaeranthera tanacetifolia*
False gold groundsel	*Packera pseudaurea*
Threetooth ragwort	*Packera tridenticulata*
Fiddleleaf hawksbeard	*Psilochenia runcinata*
Lanceleaf goldenweed	*Pyrrocoma lanceolata*
Blackeyed Susan	*Rudbeckia hirta*
Manyflower false threadleaf	*Schkuhria multiflora*
Broomlike ragwort	*Senecio multicapitatus*
Broom groundsel	*Senecio spartioides*
Canada goldenrod	*Solidago canadensis*
Missouri goldenrod	*Solidago missouriensis*
Spiny sowthistle	*Sonchus asper*
Moist sowthistle	*Sonchus uliginosus*
Western aster	*Symphyotrichum ascendens*
White heath aster	*Symphyotrichum ericoides*
White prairie aster	*Symphyotrichum falcatum*
Leafy rayless aster	*Symphyotrichum frondosum*
White panicle aster	*Symphyotrichum lanceolatum*
Yellow salsify	*Tragopogon dubius*

Common Name	Scientific Name
Boraginaceae	
Cryptantha	*Cryptantha* sp.
Manyflower stickseed	*Hackelia floribunda*
Seaside heliotrope	*Heliotropium curassavicum*
Flatspine stickseed	*Lappula occidentalis*
James' cryptantha	*Oreocarya pustulosa*
Sleeping popcornflower	*Plagiobothrys scouleri*
Common comfrey	*Symphytum officinale*
Brassicaceae	
Herb sophia	*Descurainia sophia*
Hoary Cress (small white-top)	*Cardaria draba*
Peppergrass	*Lepdium montanum*
Tall Whitetop	*Lepidium latifolium*
Tansymustard	*Descurainia* spp.
Rape	*Brassica napus*
Shepherd's purse	*Capsella bursa-pastoris*
Lenspod whitetop	*Cardaria chalepensis*
Broadleaved pepperweed	*Cardaria latifolia*
Villa grove tansymustard	*Descurainia ramosissima*
Western wallflower	*Erysimum asperum*
Field pepperweed	*Lepdium campestre*
Mesa pepperwort	*Lepidium alyssoides*
Manybranched pepperweed	*Lepidium ramosissimum*
Spreading yellowcress	*Rorippa sinuata*
Southern marsh yellowcress	*Rorippa teres*
Tall tumblemustard	*Sisymbrium altissimum*
Flaxleaf plainsmustard	*Sisymbrium linifolium*
Cactaceae	
Prickly pear	*Opuntia* spp.
Campanulaceae	
Parry's bellflower	*Campanula parryi*
Cannabaceae	
Common hop	*Humulus lupulus*
Caprifoliaceae	
Honeysuckle	*Lonicera* sp.
Tatarian honeysuckle	*Lonicera tatarica*
Caryophyllaceae	
Chickweed	*Cerastium* spp.
Drummond's campion	*Silene drummondii*
Chenopodiaceae	
Russian thistle	*Salsola iberica*
Four-wing saltbush	*Atriplex canescens*
Goosefoot	*Chenopodium murale*
Greasewood	*Sarcobatus vermiculatus*
Saltlover	*Halogeton glomeratus*
Kochia	*Kochia scoparia*
Lambsquarters	*Chenopodium album*
Pickleweed	*Salicornia rubra*
Pursh seepweed	*Suaeda calceoliformis*
Winterfat	*Krascheninnikovia lanata*
Silverscale saltbush	*Atriplex argentea*
Twoscale saltbush	*Atriplex heterosperma*
Wolf's saltweed	*Atriplex wolfii*
Pinyon goosefoot	*Chenopodium atrovirens*
Zschack's goosefoot	*Chenopodium berlandieri*
Fremont's goosefoot	*Chenopodium fremontii*
Rocky Mountain goosefoot	*Chenopodium glaucum*
Narrowleaf goosefoot	*Chenopodium leptophyllum*
Desert goosefoot	*Chenopodium pratericola*
Hairy bugseed	*Corispermum villosum*
Winged pigweed	*Cycloloma atriplicifolium*
Slender Russian thistle	*Salsola collina*
Fetid goosefoot	*Teloxys graveolens*
Cleomaceae	
Slender spiderflower	*Cleome multicaulis*
Rocky Mountain bee plant	*Cleome serrulata*
Convolvulaceae	
Field bindweed	*Convolvulus arvense*
Cupressaceae	
Rocky Mountain juniper	*Sabina scopulorum*
Eastern redcedar	*Sabina virginiana*
Cyperaceae	
Hardstem bulrush	*Schoenoplectus acutus*
Nebraska sedge	*Carex nebrascensis*
Nevada bulrush	*Scirpus nevadensis*
Sedge spp.	*Carex* spp.
Softstem bulrush	*Schoenoplectus tabernaemontani*
Spikerush	*Eleocharis* spp.
Common three-Square	*Schoenoplectus pungens*
Bearded flatsedge	*Cyperus aristatus*
Panicled bulrush	*Scirpus microcarpus*
Cloaked bulrush	*Scirpus pallidus*

Common Name	Scientific Name
Elaeagnaceae	
Russian olive	*Elaeagnus angustifolia*
Equisetaceae	
Field horsetail	*Equisetum arvense*
Smooth horsetail	*Equisetum laevigata*
Scouring rush	*Equisetum hyemale*
Horsetail	*Equisetum* spp.
Euphorbiaceae	
Spotted spurge	*Euphorbia maculate*
Ribseed sandmat	*Chamaesyce glyptosperma*
Thymeleaf sandmat	*Chamaesyce serpyllifolia*
Rocky Mountain spurge	*Tithymalus brachyceras*
Fabaceae	
American vetch	*Vicia americana*
Purple locoweed	*Oxytropis lambertii*
Mountain goldenbanner	*Thermopsis montana*
Goldenbanner	*Thermopsis rhombifolia*
Alkali swainsonpea	*Sphaerophysa salsula*
Sweet clover	*Melilotus officinalis*
Wild licorice	*Glycyrrhiza lepidota*
Alfalfa	*Medicago sativa*
Clover	*Trifolium* spp.
Purple Milkvetch	*Astragalus agrestis*
Bodin's milkvetch	*Astragalus bodinii*
Painted milkvetch	*Astragalus ceramicus*
Hall's milkvetch	*Astragalus hallii*
Siberian peashrub	*Caragana arborescens*
King's lupine	*Lupinus kingii*
Black medick	*Medicago lupulina*
Blue nodding locoweed	*Oxytropis deflexa*
White locoweed	*Oxytropis sericea*
Lemon scurfpea	*Psoralidium lanceolatum*
Garden vetch	*Vicia angustifolia*
Fumaraceae	
Scrambled eggs	*Corydalis aurea*
Gentianaceae	
Gentian	*Gentiana detonsa*
Pleated gentian	*Gentiana affinis*
Autumn dwarf gentian	*Gentianella strictiflora*
Rocky Mountain fringed	*Gentian Gentianopsis thermalis*
Geraniaceae	
Redstem stork's bill	*Erodium cicutarium*

Common Name	Scientific Name
Pineywoods geranium	*Geranium caespitosum*
Grossulariaceae	
Golden currant	*Ribes aureum*
Whitestem gooseberry	*Ribes inerme*
Trumpet gooseberry	*Ribes leptanthum*
Haloragaceae	
Eurasian watermilfoil	*Myriophyllum spicatum*
Water milfoil	*Myriophyllum exalbescens*
Hippuridaceae	
Mare's tail	*Hippuris vulgaris*
Hydrophyllaceae	
Wishbone fiddleleaf	*Nama dichotomum*
White phacelia	*Phacelia alba*
Iridaceae	
Wild iris	*Iris missouriensis*
Stiff blue-eyed grass	*Sisyrinchium demissum*
Juncaceae	
Baltic rush	*Juncus balticus*
Toad rush	*Juncus bufonius*
Inland rush	*Juncus interior*
Longstyle rush	*Juncus longistylis*
Rocky Mountain rush	*Juncus saximontanus*
Torrey's rush	*Juncus torreyi*
Juncaginaceae	
Seaside arrowgrass	*Triglochin maritimum*
Slender arrowgrass	*Triglochin concinna*
Marsh arrowgrass	*Triglochin palustris*
Lamiaceae	
Field mint	*Mentha arvensis*
Spearmint	*Mentha spicata*
Wild mint	*Mentha arvensis*
Hairy hedgenettle	*Stachys palustris*
Lemnaceae	
Duckweed	*Lemna* spp.
Loasaceae	
Bractless blazingstar	*Mentzelia nuda*
Adonis blazingstar	*Nuttallia multiflora*
Malvaceae	
Salt spring checkerbloom	*Sidalcea neomexicana*
Scarlet globemallow	*Sphaeralcea coccinea*
Nyctaginaceae	
Hairy four o'clock	*Oxybaphus hirsutus*
Narrowleaf four o'clock	*Oxybaphus linearis*

Common Name	Scientific Name
Heartleaf four o'clock	*Oxybaphus nyctagineus*
Smallflower sandverbena	*Tripterocalyx micranthus*
Oleaceae	
Common lilac	*Syringa vulgaris*
Onagraceae	
Yellow evening-primrose	*Oenothera flava*
Fringed willowherb	*Epilobium ciliatum*
Crownleaf evening-primrose	*Oenothera coronopifolia*
Pale evening-primrose	*Oenothera pallida*
Hairy evening-primrose	*Oenothera villosa*
Orchidaceae	
Northern green orchid	*Platanthera aquilonis*
Orobanchaceae	
Louisiana broomrape	*Orobanche ludoviciana*
Yellow owl's-clover	*Orthocarpus luteus*
Phrymaceae	
Roundleaf monkeyflower	*Mimulus glabratus*
Pinaceae	
Engelmann spruce	*Picea engelmannii*
Blue spruce	*Picea pungens*
Plantaginaceae	
Common plantain	*Plantago major*
Nodding buckwheat	*Eriogonum cernuum*
Longroot smartweed	*Persicaria amphibia*
Curlytop knotweed	*Persicaria lapathifolia*
Redwool plantain	*Plantago eriopoda*
Oval-leaf knotweed	*Polygonum arenastrum*
Silversheath knotweed	*Polygonum argyrocoleon*
Poaceae	
Alkali cordgrass	*Spartina gracilis*
Alkali muhly	*Muhlenbergia asperfolia*
Alkali sacaton	*Sporobulus airodes*
Barnyard grass	*Echinochloa crusgalli*
Beardless wildrye	*Leymus triticoides*
Blue grama	*Bouteloua gracilis*
Bluejoint reedgrass	*Calamagrostis canadensis*
Brome spp.	*Bromus* spp.
Common rye	*Secale cereale*
Creeping wildrye	*Elymus triticoides*
Foxtail barley	*Hordeum jubatum*
Grass spp.	*Gramancea* spp.
Indian ricegrass	*Oryzopsis hymenoides*

Common Name	Scientific Name
Johnsongrass	*Sorghum halipense*
Mat muhly	*Muhlenbergia richardsonis*
Nuttall's alkali grass	*Puccinellia nuttalliana*
Phragmites	*Phragmites australis*
Prairie wedgegrass (Reedgrass)	*Spenopholis obtusata*
Rabbitfoot grass	*Polypogon monspeliensis*
Reed canarygrass	*Phalaris arundinaceae*
Reedgrass	*Calimagrostis neglecta*
Saltgrass	*Distichlis spicata*
Sand dropseed	*Sporobolus cryptandrus*
Sandhill muhly	*Muhlenbergia pungens*
Short-awn foxtail	*Alopecurus aequalis*
Slender wheatgrass	*Agropyron trachycaulum*
Slimstem reedgrass	*Calamagrostis neglecta*
Sloughgrass	*Beckmannia syzigachne*
Spike bentgrass	*Agrostis exarata*
Spikedropseed	*Sporobolus contractus*
Squirrel tail	*Elymus elymoides*
Timothy	*Phleum pratense*
Tufted hairgrass	*Deschampsia cespitosa*
Weeping alkaligrass	*Puccinellia distans*
Western wheatgrass	*Pascopyrum smithii*
Sleepygrass	*Achnatherum robustum*
Crested wheatgrass	*Agropyron cristatum*
Redtop	*Agrostis gigantea*
Shortawn foxtail	*Alopecurus aequalis*
Creeping meadow foxtail	*Alopecurus arundinaceus*
Purple threeawn	*Aristida purpurea*
American sloughgrass	*Beckmannia syzigachne*
Smooth brome	*Bromopsis inermis*
Cheatgrass	*Bromus tectorum*
Slimstem reedgrass	*Calamagrostis stricta*
Blue grama	*Chondrosum gracile*
Foxtail barley	*Critesion jubatum*
MacKenzie's hairgrass	*Deschampsia caespitosa*
Saltgrass	*Distichlis stricta*
Quackgrass	*Elytrigia repens*
Stinkgrass	*Eragrostis cilianensis*
American mannagrass	*Glyceria grandis*
Needle and thread	*Hesperostipa comata*
Prairie Junegrass	*Koeleria macrantha*
False buffalograss	*Monroa squarrosa*
Scratchgrass	*Muhlenbergia asperifolia*

Common Name	Scientific Name
Pullup muhly	*Muhlenbergia filiformis*
Annual muhly	*Muhlenbergia minutissima*
Witchgrass	*Panicum capillare*
Canada bluegrass	*Poa compressa*
Kentucky bluegrass	*Poa pratensis*
Sand dropseed	*Sporobolus cryptandrus*
Polemoniaceae	
Scarlet gilia	*Ipomopsis aggregata*
Flaxflowered ipomopsis	*Ipomopsis longiflora*
Polygonaceae	
Curly dock	*Rumex crispus*
Erect knotweed	*Polygonum erectum*
Smartweed	*Polygonum amphibium*
Western dock	*Rumex occidentalis*
Mexican dock	*Rumex triangulivalvis*
Portulacaceae	
Little hogweed	*Portulaca oleracea*
Potamogetonaceae	
Horned pondweed	*Zannichellia palustris*
Pondweed	*Potamageton* spp.
Sago pondweed	*Potamageton pectinatus*
Primulaceae	
Sea milkwort	*Glaux maritima*
Ranunculaceae	
Buttercup	*Ranunculus cymbalaria*
Western white clematis	*Clematis ligusticifolia*
Threadleaf crowfoot	*Ranunculus aquatilis*
Macoun's buttercup	*Ranunculus macounii*
Rhamnaceae	
Common buckthorn	*Rhamnus cathartica*
Rosaceae	
Herbaceous cinquefoil	*Potentilla nivea*
Silverweed cinquefoil	*Argentina anserine*
Apple	*Malus*
Paradox cinquefoil	*Potentilla paradoxa*
Platte River cinquefoil	*Potentilla plattensis*
Woods' rose	*Rosa woodsii*
Rubiaceae	
Northern bedstraw	*Galium boreale*
Salicaceae	
Coyote willow	*Salix exigua*
Crack willow	*Salix fragilis*
Narrow-leaf cottonwood	*Populus angustifolia*

Common Name	Scientific Name
Peach-leaf willow	*Salix amygladoides*
Plains cottonwood	*Populus deltoides*
Lombardy poplar	*Populus nigra*
Quaking aspen	*Populus tremuloides*
Strapleaf willow	*Salix ligulifolia*
Greenleaf willow	*Salix lucida*
Santalaceae	
Pale bastard toadflax	*Comandra umbellata*
Scrophulariceae	
Water speedwell	*Veronica anagallis-aquatica*
Neckweed	*Veronica peregrina*
Butter and eggs	*Linaria vulgaris*
Meadow lousewort	*Pedicularis crenulata*
Oneside penstemon	*Penstemon virgatus*
Common mullein	*Verbascum thapsus*
Solanaceae	
Matrimony vine	*Lycium barbarum*
Cutleaf nightshade	*Solanum triflorum*
Sparganiaceae	
Giant Bur-reed	*Sparganium eurycarpum*
Tamaricaeae	
Matrimony vine	*Lycium barbarum*
Cutleaf nightshade	*Solanum triflorum*
Saltcedar	*Tamarix ramosissima*
Typha	
Cattail	*Typha latifolia*
Ulmaceae	
Siberian elm	*Ulmus pumila*
Urticaceae	
Stinging nettle	*Urtica gracilis*
Valerianaceae	
Tobacco root	*Valeriana edulis*
Verbenaceae	
Bigbract verbena	*Verbena bracteata*
Vitaceae	
Virginia creeper	*Parthenocissus quinquefolia*
Zygophyllaceae	
Puncturevine	*Tribulus terrestris*

Bibliography

Abbe, T.B.; Montgomery, D.R. 1996. Large woody debris jams, channel hydraulics and habitat formation in large rivers. Regulated Rivers: Research and Management 12(2–3):201–221.

Adamcik, R.S.; Bellantoni, E.S.; Delong, DC; Schomaker, J.H., Jr.; Hamilton, D.B.; Laubhan, M.K.; Schroeder, R.L. 2004. Writing refuge management goals and objectives: a handbook. Washington, DC: U.S. Fish and Wildlife Service. 34 p.

Ames, C.R. 1977. Wildlife conflicts in riparian management: grazing. In: Johnson, R.R.; Jones Jr., D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; July 9, 1977; Tuscon, AZ. U.S. Department of Agriculture, Forest Service, Washington D.C.: General Technical Report RM-43. 49–51.

Anderholm, S. 1993. Water-quality assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas; shallow groundwater quality of a land-use area in the San Luis Valley, South-Central Colorado 1993. Water Resource Investigation Report 96-4144. 102 p.

Anderson, B.W.; Ohmart, R.D. 1977. Vegetation structure and bird use in the lower Colorado River Valley. In: Johnson, R.R.; Jones Jr., D.A., tech. coords. Importance, preservation and management of riparian habitat: a symposium. U.S. Department of Agriculture, Forest Service, Washington D.C.: General Technical Report RM-43. 23–34.

Andrei, A.E.; Smith, L.M.; Haukos, D.A.; Surles, J.G. 2006. Community composition and migration chronology of shorebirds using the saline lakes of the Southern Great Plains, USA. Journal of Field Ornithology 77:372–383.

Andrews R. and Righter R. 992. Colorado Birds: A reference to their distribution and habitat. Denver Museum of Natural History. 1st edition. Denver, CO. 442 p.

Arno, S.F.; Parsons, D.J.; Keane, R.E. 2000. Mixed-severity fire regimes in the northern Rocky Mountains: consequences of fire exclusion and options for the future. Wilderness science in a time of change conference-Volume 5. Wilderness ecosystems, threats, and management; May 23-27, 1999; Missoula MT. Proceedings RMRS-P-15-VOL-5. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. p. 225-232.Askins, R.A. 1993. Population trends in grassland, shrubland, and forest birds in eastern North America. Current Ornithology 11:1–34.

Athearn, Frederic J. 1989. A forgotten kingdom: the Spanish frontier in Colorado and New Mexico, 1540–1821. Cultural Resource Series Number 29. Lakewood, COColorado: Colorado State Office, Bureau of Land Management. 217p.

———.1985. Land of contrast: a history of southeast Colorado. Cultural Resources Series Number 17. Denver, CO: Bureau of Land Management. 275.

Averyt, K.; Cody, K.; Gordon, E.; Lein, R.; Lukas, J.; Smith, J.; Travis, W.; Udall, B.; Vogel, J. 2011. Colorado climate preparedness project: final report. Prepared by the Western Water Assessment for the State of Colorado. Boulder, CO: University of Colorado. 114 p. <http://wwa.colorado.edu/publications/reports/WWA_ColoClimatePreparednessProject_Report_2011.pdf.> accessed November 20, 2013.

Baca Grande Property Owners Association. 2012. Baca Grande design guidelines and requirements: information for living and building in the Baca Grande. Crestone, CO. Revised August 23, 2012. 41 p. <www.bacapoa.org> accessed July 2013.

Bachman, G.O.; Mehnart, H.H. 1978. New Kar dates and the late Pliocene to Holocene geomorphic history of the central Rio Grande region, New Mexico. Geological Society of America Bulletin 89:283–292.

Barron, T. 1996. Restoration guidelines for riparian areas using dormant stock “pole” cuttings. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: bringing interests and concerns together. U.S. Department of Agriculture, Forest Service, General Technical Report RM-GTR-272. Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 260–261.

Batzer, D.P.; Resh, V.H. 1992. Macroinvertebrates of California seasonal wetland and responses to experimental habitat manipulation. Wetlands 12:1–7.

Belsky A.J.; Matzke, A; Uselman, S. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation; Vol 54-1. 419-431.

Behnke, N.J.; Raleigh, R.F. 1978. Grazing and the riparian zone: impact on management perspectives. In: Johnson, R.; McCormick, J.F., eds. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. U.S. Forest Service, General Technical Report WO-12. 263–67.

Bent, A.C. 1962. Life histories of North American shorebirds. Part 1. New York, NY: Dover Publications, Inc. 602 p.

Biggins, D.E.; Godbey, J.L.; Gage, K.L.; Carter, L.G.; Montenieri, J.A. 2010. Vector control improves survival of three species of prairie dogs *(Cynomys)* in areas considered enzootic for plague. Vector-borne and Zoonotic Diseases 10(1):17–26.

Blevins, Jason. 2012. Forest Service study supports land exchange at Colorado's Wolf Creek. Denver Post. <http://www.denverpost.com/ci_21339387/forest-service-study-supports-land-exchange-at-colorados21339387/forest-service-study-supports-land-exchange-at-colorados> Accessed February 2014.

Bock, C.E.; Saab, V.A.; Rich, T.D.; Dobkin, D.S. 1993. Effects of livestock grazing on neotropical migratory landbirds in western North America. In: Finch, D.M.; Stangel, P.W., eds. Status and management of neotropical migratory birds. September 21–25, 1992, Estes Park, Colorado. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-229. 422 p. 296–309.

Brendle, D. 2002. Geophysical logging to determine construction, contributing zones, and appropriate use of water levels measured in confined-aquifer network wells, San Luis Valley, Colorado, 1998–2000. Water Resources Investigations Report 02-4058. Denver, CO: U.S. Geological Survey. 62p.

Brennan, Leonard A.; Kuvlesky, William P., Jr. 2005. North American grassland birds: an unfolding conservation crisis? Journal of Wildlife Management 69(1):1–13.

Brister B. and Gries, R.G.1994. Teriary stratigraphy and tectonic development of the Alamosa basin (northern San Luis Basin), Rio Grande rift, south-central Colorado. Geological Society of America Special Papers. V.291. (39-58).

Brode, J.M.; Bury, R.B. 1984. The importance of riparian systems to amphibians and reptiles. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems. Berkeley, CA: University of California Press. 30–36.

Brown and Caldwell. 2009. Environmental assessment. Prepared for Baca Grande Water and Sanitation District, Saguache County, Colorado. Golden, CO: Brown and Caldwell.

Brown, S.; Hickey, C.; Harrington, B.; Gill, R. 2001. United States shorebird conservation plan. Manomet, MA: Manomet Center for Conservation Sciences.

Burnett, Sara; Jaffe, Mark. Sprawling solar plant on tap for San Luis Valley: Saguache commissioners issue a permit for a complex that has triggered some environmental concerns. Denver Post. March 27. [Internet]. <http://www.denverpost.com/ci_20262088/sprawling-solar-plant-tap-san-luis-valley> accessed January 14, 2014.

Burroughs, R.L. 1981. A summary of geology of the San Luis Basin, Colorado and New Mexico, with emphasis on the geothermal potential for the Monte Vista graben. Special Publication 17. [No place of publication]. Colorado Geological Survey. 30 p.

Bury, R.B. 1988. Habitat relationships and ecological importance of amphibians and reptiles. In: Raedeke, K., ed. Streamside management: riparian wildlife and forestry interaction. Contribution No. 59. University of Washington, Institute of Forest Resources. 277 p. 66–76.

Busch, J.D.; Miller, M.P.; Paxton, E.H.; Sogge, M.K.; Keim, P. 2000. Genetic variation in the endangered Southwestern willow flycatcher. The Auk 117 (3) 586-596.

Cappa, J.A.; Young, G.; Burnell, J.R.; Carrol, C.J.; Widman, B. 2007. Colorado mineral and energy industry activities, 2006. Colorado Geological Survey Information Series 75.

Carothers, S.W.; Johnson R.R. 1975. Water management practices and their effects on non-game birds in range habitats. In: Symposium Management. Forest and range habitats for nongame birds. U.S. Forest Service General Technical Report WO-1. 210–12.

Carson, Phil. 1998. Across the northern frontier: Spanish explorations in Colorado. Boulder, CO: Johnson Books. 254p.

Carter, Carrol Joe. 1978. Pike in Colorado. Fort Collins, CO: The Old Army Press. 83p.

Carver, Erin; Caudill, James. 2007. Banking on nature, 2006: the economic benefits to local communities of national wildlife refuge visitation. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service, Division of Economics. 382 p.

———. 2013. Banking on nature. The economic benefits to local communities of National Wildlife Refuge visitation. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service, Division of Economics. 365 p.

Case, R.L.; Kauffman, J.B. 1997. Wild ungulate influences on the recovery of willows, black cottonwood and thin-leaf alder following cessation of cattle grazing in northeastern Oregon. Northwest Science 71:115–126.

Cassells, E.S. 1997. The archaeology of Colorado. Boulder, CO: Johnson Books.

Center for . [Internet]. <http://www.southwestbooks.org> accessed March 1, 2012

Chapin, L.C. 1971. The Rio Grande rift, Part I: modifications and additions. In: James, H.L., ed. Guidebook of the San Luis Basin, Colorado. New Mexico Geological Society 22nd Annual Field Conference Report. 191–201.

Colorado Department of Agriculture. 2013. Noxious weed management program. [Internet]. <www.colorado.gov/cs/Satellite?c=Page&cid=1174084048733&pagename=Agriculture-Main2FCDAGLayout> accessed December 30, 2013.

Colorado Department of Public Health and Environment. 2013. Air Pollution Control Division smoke program. [Internet]. <http://www.colorado.gov/cs/Satellite?c=Page&childpagename=CDPHE-AP2FCBONLayout&cid=1251610086794&pagename=CBONWrapper> accessed September 2013.

Colorado Department of Local Affairs. 2012. Population forecast for the years 2010–2040. [Internet]. <http://www.colorado.gov/cs/Satellite?c=Page&childpagename=DOLA-Main2FCBONLayout&cid=1251593346867&pagename=CBONWrapper> accessed September 27, 2013.

Colorado Division of Water Resources. 2000. Rio Grande decision support system. [Internet]. <dwrftp.state.co.us/cdss.> [Access date unknown].

CDOW 2005. Guidelines for response to gray wolf reports in Colorado. Colorado Division of Wildlife. January 2005. 19 pages. <http://www.cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/Wolf/graywolfguidelines.pdf> Accessed March, 26, 2014.

Colorado Division of Wildlife. 2006. Colorado's comprehensive wildlife conservation strategy and wildlife action plans. Denver, CO. 339 p.

———. 2007. A guide to wildlife viewing and photography blinds: creating facilities to connect people with nature featuring blinds from the western United States. Denver, CO. 43 p.

Colorado Parks and Wildlife. 2013a. CWD Info and Testing [Internet]. <http://wildlife.state.co.us/hunting/biggame/cwd/Pages/CWDHome.aspx> accessed November 2013.

———. 2013b [CDOW]. Natural Diversity Information Source [Internet]. <http://ndis.nrel.colostate.edu/wildlifespx.asp?SpCode=050127> accessed October 2013.

———. 2013c. Threatened and endangered list. [Internet]. <http://wildlife.state.co.us/WildlifeSpecies/SpeciesOfConcern/ThreatenedEndangeredList/Pages/ListOfThreatenedAndEndangeredSpecies.aspx> accessed November 25, 2013.

Colorado State Archives. 2001. Spanish-Mexican land grants. [Internet]. <http://www.colorado.gov/dpa/doit/archives/mlg/mlg.html> accessed March 17, 2011.

Colorado State Demography Office. 2011. Population estimates and projections. [Internet] <http://www.colorado.gov/cs/Satellite/DOLA-Main/CBON/1251590805419>. Accessed January 15, 2013.

Colorado State University. 2013. IMPROVE: interagency monitoring of protected visual environments. [Internet] <http://vista.cira.colostate.edu/improve/> accessed November 21, 2013.

Colville, R.M. 1995. La Vereda: a trail through time. Alamosa, CO: San Luis Valley Historical Society. [367 pages.

Colwell, M.A.; Oring, L.W. 1990. Nest site characteristics of prairie shorebirds. Canadian Journal of Zoology 68:297–302.

Conway, W.C. 2001. Shorebird breeding ecology in the playa lakes region of Texas [Ph.D. dissertation]. Lubbock, TX: Texas Tech University.

Conway, W.C.; Smith, L.M.; Ray, J.D. 2005a. Shorebird breeding biology in wetlands of the playa lakes, Texas, USA. Waterbirds 28:129–138.

———.2005b. Shorebird habitat use and nest-site selection in the playa lakes region. Journal of Wildlife Management 69:174–184.

Cooper, D.J. 1996. Wetlands of the San Luis Valley, Colorado. In: Thompson, R.A.; Hudson, M.R.; Pillmore, C.L., eds. Geologic excursions to the Rocky Mountains and beyond: Field Trip Guidebook for the 1996 Annual Meeting, Denver Colorado, CO:Geological Society of America; Colorado Geological Survey, Department of Natural Resources, Denver, Colorado.

Cooper, D.J.; Severn, C. 1992. Wetlands of the San Luis Valley, Colorado: an ecological study and analysis of the hydrologic regime, soil chemistry, vegetation and the potential effects of a water table drawdown. Report to Colorado Division of Wildlife, U.S. Fish and Wildlife Service, and Rio Grande Water Conservation District, Boulder, Colorado.

Cooper, D.J.; Merrit, D.M.; Anderson, DC; Chimer, R.A. 1999. Factors controlling the establishment of Fremont cottonwood seedlings on the upper Green River, USA. Regulated Rivers: Research and Management 15:419–440.

Cooper, D.J.; Groenveld, D.P.; Chimner, R.A.; Sanderson, J. 2000. Characterization of three functional ecosystems based upon evapotranspiration relationships in the San Luis Valley, Colorado. [Unpublished report].

Correa, Karina Elena. 2007. Reconstructing streamflow in the upper Rio Grande River basin. January 1, 2007. El Paso, TX: University of Texas. Paper AAI1444136.

Coues, Elliot. 1965. The journal of Jacob Fowler: narrating an adventure from Arkansas through the Indian Territory, Oklahoma, Kansas, Colorado and New Mexico to the sources of Rio Grande Del Norte, 1821–1822. Edited with notes by Elliott Coues. Copyright 1898 by Francis P. Harper. Minneapolis, MN: Ross & Haines, Inc.

Cowan, James P. 1994. Handbook of Environmental Acoustics. John Wiley & Sons, New York, NY. 296p.

Cowardin, L.M.; Carter, V.; Golet, F.C.; LaRoe, E.T. 1979. Classification of wetlands and deepwater habitats of the United States. Series: U.S. Fish and Wildlife Service. Biological Services Program; FWS/OBS-79/31.

Creel, D.; Scott, R.F., IV; Collins, M.B. 1990. A faunal record from west central Texas and its bearing on late holocene bison population changes in the southern plains. Plains Anthropologist 35(127):55–69.

Cross, S.P. 1985. Responses of small mammals to forest riparian perturbations. In: R.R. Johnson; Ziebell, C.D.; Patten, D.R.; Folliot, P.F.; Hamre, R.H.; tech. coords. Riparian ecosystems and their management: reconciling conflicting uses. [Place of publication unknown].U.S. Department of Agriculture, Forest Service. General Technical Report RM-120. 269–275.

Cully, J.F., Jr.; Williams, E.S. 2001. Interspecific comparisons of sylvatic plague in prairie dogs. Journal of Mammalogy 82(4):894–905.

Cummins, K.W. 1974. Structure and function of stream ecosystems. Bio-science 24:631–641.

Darveau, M.; Beauchessne, P.; Belanger, L.; Huot, J.; Larue, P. 1995. Riparian forest strips as habitat for breeding birds in boreal forest. Journal of Wildlife Management 59:67–78.

Davis, C.A.; Smith, L.M. 1998. Ecology and management of migrant shorebirds in the playa lakes region of Texas. Wildlife Monographs 140:1–45.

Davis Engineering Service, Inc.; Principia Mathematica, Inc. 2012. Draft: San Luis Valley well and water-level database. February 23, 2012. [Internet]. SLVP Well and Water-Level Database. <http://www.prinmath.com/rgwcd/> accessed March 16, 2012.

Dechant, J.A.; Johnson, D.H.; Igl, L.D.; Goldade, C.M.; Zimmerman, A.L.; Euliss, B.R. 2003. Effects of management practices on grassland birds: Wilson's phalarope. Jamestown, ND: Northern Prairie Wildlife Research Center. Northern Prairie Wildlife Research Center Online. <http://www.npwrc.usgs.gov/resource/literatr/grasbird/wiph/wiph.htm> (Version 12DEC2003).

Dieni, J.S. 2010a. Post-breeding and fall migration bird use of wet meadows at Baca National Wildlife Refuge, Colorado. Technical Assistance Report. 20 p.

———. 2010b. The effects of haying on wet-meadow birds and habitat at Baca National Wildlife Refuge, Colorado. Technical Assistance Report. 53 p.

Dobkin, D.S.; Wilcox, B.A. 1986. Analysis of natural forest fragments: riparian birds in the Toiyabe Mountains, Nevada. In: Verner, J.; Morrison, M.L.; Ralph, C.J., eds. Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. Madison, WI: University of Wisconsin Press. 293–299.

Dombeck, M.P.; Williams, J.E.; Wood, C.A. 2004. Wildfire policy and public lands: integrating scientific understanding with social concerns across landscapes. Conservation Biology 18(4):883–889.

Drewien, R.C.; Bizeau, E.G. 1974. Status and distribution of greater sandhill cranes in the Rocky Mountains. Journal of Wildlife Management 38:720–742.

Durst, S.L.; Sogge M.K.; Stump, S.D.; Walker, H.A.; Kus, B.E.; Sferra, S.J. 2008. Southwestern willow flycatcher breeding sites and territory summary: 2007. U.S. Geological Survey Open File Report 2008-1303. 31 p.

Ellis, S.R.; Levings, G.W.; Carter, L.F.; Richey, S.F.; Radel, M.J. 1993. Rio Grande Valley, Colorado, New Mexico, and Texas. American Water Resources Association Water Resources Bulletin 29. 617–646.

Ellis, R. 1996. The Utes in the western San Juan Mountains: their geology, ecology and human history. [Place of publication unknown]: University Press of Colorado.

Ellison, L.E. 2011. Species accounts for the Alamosa/Monte Vista/Baca National Wildlife Refuge Complex. U.S. Geological Survey Open-File Report 2011-1285. 195 p.

Emery, P.A. 1996. Hydrogeology of the San Luis Valley, Colorado: an overview and look at the future. In: Thompson, R.A.; Hudson, M.R.; Pillmore, C.L., eds. Geologic excursions to the Rocky Mountains and beyond. Denver, CO: Colorado Geological Survey

Emery, P.A.; Snipes, R.J.; Dunmeyer J.M.; Kein J.M. 1973. Water in the San Luis Valley, south-central Colorado. Colorado Water Resources Circular 18. Colorado Water Conservation Board.

Elmore, W.; Beschta, R.L. 1987. Riparian areas: perceptions in management. Rangelands 9:260–265.

Espinosa, J.M. 1939. Journal of the Vargas expedition into Colorado: 1694. The Colorado Magazine 3:81–90.

Friends of the San Luis Valley National Wildlife Refuges. 2013. Wetlands curriculum for grades K-5. [Internet] <http://www.slvrefuges.org/> accessed December 2013.

Euliss, N.H., Jr.; LaBaugh, J.W.; Fredrickson, L.H.; Mushet, D.M.; Laubhan, M.K.; Swanson, G.A.; Winter, T.C.; Rosenberry, D.O.; Nelson, R.D. 2004. The wetland continuum: a conceptual framework for interpreting biological studies. Wetlands 24:448–458.

Evans, K.E.; Kerbs, R.R. 1977. Avian use of livestock watering ponds in western South Dakota. USDA Forest Service General Technical Report RM-35. [Place of publication unknown].

Fellows, S.; Stone, K.; Jones, S.; Damude, N.; Brown, S. 2001. Central Plains/playa lakes regional shorebird conservation plan. Version 1.0. 26 p.

Finch, D.M. 1991. Population ecology, habitat requirements, and conservation of neotropical migratory birds. U.S. Forest Service General Technical Report RM-205. [Place of publication unknown].

Fischman, Robert L. 2005. The significance of national wildlife refuges in the development of U.S. conservation policy. Journal of Land Use 21(1). 22 p.

Freemark, K.E.; Dunning, J.B.; Hejl, S.J.; Probst, J.R. 1995. A landscape ecology perspective for research, conservation, and management. In: T.E. Martin; D.M. Finch, eds. Ecology and management of neotropical migratory birds: a synthesis and review of critical issues. New York, NY: Oxford University Press. 381–427.

Gebauer, M. 2004. Sage thrasher *(Oreoscoptes montanus)*: accounts and measures for managing identified wildlife – Accounts V. 2004. [Place of publication unknown]. Government of British Columbia, Ministry of Water, Land, and Air Protection.

General Accounting Office. 1989. Report to Congressional requesters: national wildlife refuges—continuing problems with incompatible uses call for bold action. [Internet]. <http://archive.gao.gov/d26t7/139500.pdf> accessed September 2011. 88 p.

Gilbert, D.W.; Anderson, D.R.; Ringleman, J.K.; Szymczak, M.R. 1996. Response of nesting ducks to habitat and management on the Monte Vista National Wildlife Refuge, Colorado. Wildlife Monographs 131:1–44.

Gregory, S.V.; Swanson, F.J.; McKee, W.A.; Cummins, K.W. 1991. An ecosystem perspective of riparian zones: focus on links between land and water. BioScience 41:540–551.

Greystone Environmental Consultants, Inc. 2004. Draft Baca National Wildlife Refuge Wildland Fuels Assessment. Prepared for U.S. Fish and Wildlife Service, Mountain-Prairie Region, Denver, CO. [Place of publication unknown]. 29p.

Guilinger, J.R; J.W. Keller. 2000. Directory of active and permitted mines in Colorado: 2002. Colorado Geological Survey Information Series 68.

Gunderson, D.R. 1968. Floodplain use related to stream morphology and fish populations. Journal of Wildlife Management. 32:507–514.

Gutzwiller, K.J.; Wiedenmann, R.T.; Clements, K.L.; Anderson, S.H. 1994. Effects of human intrusion on song occurrence and singing consistency in subalpine birds. Auk 111:28–37.

Gutzwiller, K.J.; Kroese, E.A.; Anderson, S.H.; Wilkins, C.A. 1997. Does human intrusion alter the seasonal timing of avian song during breeding periods? Auk 114 (1):55–65.

Hagar, J.C. 1999. Influence of riparian buffer width on bird assemblages in western Oregon. Journal of Wildlife Management 63:484–496.

Hall, J.; Pollock, M.; Hoh, S. 2011. Methods for successful establishment of cottonwood and willow along an incised stream in semiarid eastern Oregon, USA. Ecological Restoration 29:261–269.

Harrington, H.D. 1954. Manual of the plants of Colorado. 2nd edition. Denver, CO: Sage Books.

Harrison, K.G. 1974. Aspects of habitat selection in grassland birds [master's thesis]. Kalamazoo, MI: Western Michigan University. 82 p.

Hart, S.H.; Hulbert, A.B., eds. 2006. The southwestern journals of Zebulon Pike: 1806–1807. Albuquerque, NM: University of New Mexico Press.

Haukos, D.A.; Smith, L.M. 1994. The importance of playa wetlands to biodiversity of the southern High Plains. Landscape and Urban Planning 28:83–98.

Havlick, David G. 2002. No place distant: roads and motorized recreation on America's public lands. Washington, DC: Island Press. 297 p.

Hehnke, M.; Stone, C.P. 1979. Value of riparian vegetation to avian populations along the Sacramento River system. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Forest Service General Technical Report WO-12. [Place of publication unknown]: U.S. Department of Agriculture. 228–235.

Heitmeyer, M.E.; Aloia, C.M. 2013a. Hydrogeomorphic evaluation of ecosystem restoration and management options for Alamosa National Wildlife Refuge. Prepared for U.S. Fish and Wildlife Service, Region 6, Lakewood, CO. Greenbrier Wetland Services Report 13-06. Bloomfield MO: Blue Heron Conservation Design and Printing LLC,. 70 p.

———. 2013b. Hydrogeomorphic evaluation of ecosystem restoration and management options for Baca National Wildlife Refuge. Prepared for U.S.

Fish and Wildlife Service, Region 6, Lakewood, CO. Greenbrier Wetland Services Report 13-07. Bloomfield, MO: Blue Heron Conservation Design and Printing LLC. 80 p.

———. 2013c. Hydrogeomorphic evaluation of ecosystem restoration and management options for Monte Vista National Wildlife Refuge. Prepared for U.S. Fish and Wildlife Service, Region 6, Lakewood, CO. Greenbrier Wetland Services Report 13-02. Bloomfield, MO: Blue Heron Conservation Design and Printing LLC. 70 p.

Hickman, S. 1990. Evidence of edge species' attraction to nature trails within deciduous forest. Natural Areas Journal 10:3–5.

Hildner M. 2009. Taylor Ranch owners appeal court's handling of access proceedings. The Pueblo Chieftain.[Internet] September 12, 2009. <http://www.chieftain.com/news/local/article_3a47173d-a18f-5af5-9ad7-545ff94a6a7c.html.> accessed March 2012

Hildner, M. 2011. Water table worries ag in San Luis Valley. The Pueblo Chieftain. March 11. [Section and column unknown].

Hoefer, T. 1999. In: Martorano, M.A.; Hoefer III, T.; Jodry, M.; Spero, V.; Taylor, M.L. Colorado prehistory: a context for the Rio Grande Basin. [Place of publication unknown]: Colorado Council of Professional Archaeologists. 115–128.

Holmes, J.A.; Johnson, M.A. 2005. Brewer's sparrow *(Spizella breweri)*: a technical conservation assessment. [Internet]. USDA Forest Service, Rocky Mountain Region. <http://www.fs.fed.us/r2/projects/scp/assessments/brewerssparrow.pdf.> accessed March 18, 2013.

Howe, M.A.; Geissler, P.H.; Harrington, B.A. 1989. Population trends of North American shorebirds based on the International Shorebird Survey. Biological Conservation 49:185–199.

Hubbard, J.P. 1977. Importance of riparian ecosystems: biotic considerations. In: Johnson, R.R.; Jones, D.A., Jr., tech. coords. Importance, preservation and management of riparian habitat: a symposium. U.S. Department of Agriculture, Forest Service General Technical Report RM-43. 14–18.

[IMJV] Intermountain Joint Venture. 2013. [Internet] http://iwjv.org. Accessed March 2014

International Wader Study Group. 2003. Waders are declining worldwide: conclusions from the 2003 International Wader Study Group Conference, Cadiz, Spain. [Internet]. <http://www.waderstudygroup.org/cons/the_cadiz_conclusions.pdf> accessed April, 24 2013.

Ivey, G.L.; Herzinger, C.P. 2006. Intermountain West waterbird conservation plan. Version 1.2. A plan associated with the waterbird conservation for the Americas Initiative. Portland, OR: U.S. Fish and Wildlife Service, Pacific Region. 206p.

Jodry, M.A.; Stanford, D.J. 1996. Changing hydrologic regimes and prehistoric landscape use in the northern San Luis Valley, Colorado. In: Geologic excusions to the Rocky Mountains and beyond. Denver, CO: Colorado Geological Survey.

Jodry, M.A. 1999a. Paleoindian Stage. Martorano, M.A.; Hoefer III, T.; Jodry, M.A; Spero, V.; Taylor, M.L. Colorado prehistory: a context for the Rio Grande basin. [Place of publication unknown]: Colorado Council of Professional Archaeologists. 45–114.

———. 1999b. Paleoindian stage paleoecological records. In: Martorano, M.A.; Hoefer III, T.; Jodry, M.A.; Spero, V.; Taylor, M.L. Colorado prehistory: a context for the Rio Grande basin. [Place of publication unknown]: Colorado Council of Professional Archaeologists. 12–26.

Jones, L.S.; J.T. Harper. 1998. Channel avulsions and related processes, and large-scale sedimentation patterns since 1875, Rio Grande, San Luis Valley, Colorado. Geological Society of America 110:411–421.

Johnson, R.R.; Haight, L.T. 1985. Avian use of xeroriparian ecosystems in the North American warm deserts. In: R.R. Johnson; Ziebell, C.D.; Patten, D.R.; Folliot, P.F.; Hamre, R.H., tech. coords. Riparian ecosystems and their management: reconciling conflicting uses. Forest Service General Technical Report RM-120. [Place of publication unknown]: U.S. Department of Agriculture. 156–160.

Johnson, R.R.; Haight, L.T.; Simpson, J.M. 1977. Endangered species vs. endangered habitats: a concept. In: Johnson, R.R.; Jones Jr., D.A., tech. coords. Importance, preservation and management of riparian habitat: a symposium. Forest Service General Technical Report RM-43. [Place of publication unknown]: U.S. Department of Agriculture. 68–79.

Kangas, K.; Luoto, M.; Ihantola, A.; Tomppo, E.; Siikamaki, P. 2010. Recreation-induced changes in boreal bird communities in protected areas. Ecological Applications 20:1775–1786.

Karl, Thomas R.; Melillo, Jerry M.; Peterson, Thomas, eds. 2009. Global climate change impacts in the United States. [Internet]. U.S. Global Change Research Program. [Place of publication unknown]. Cambridge University Press. <www.globalchange.gov> [access date unknown]. 196 p.

Kay, C.E. 1994. The impact of native ungulates and beaver on riparian communities in the Intermountain West. Natural Resource and Environmental Issues 1:23–44.

Kay, C.E.; Chadde, S. 1992. Reduction of willow seed production by ungulate browsing in Yellowstone

National Park. In: Clary, W.E.; McArthur, E.D.; Bedunah, D.; Wambolt, C.L., eds. Proceedings: symposium on ecology and management of riparian shrub communities, May 29–31,1991. Forest Service General Technical Report INT-289. [Place of publication unknown]: U.S. Department of Agriculture. 92–99.

Keigley, R.B.; Warren, J.; King, W.J. 2009. A multi-refuge program to evaluate the effect of ungulate browsing on habitat: draft report to the U.S. Fish and Wildlife Service.

Keller, C.M.E.; Robbins, C.S.; Hatfield, J.S. 1993. Avian communities in riparian forests of different widths in Maryland and Delaware. Wetlands 13:137–144.

Kessler, R. 1998. Old Spanish Trail North Branch, and its travelers. Santa Fe, NM: Sunstone Press.

Knapp, A.K.; Blair, J.M.; Briggs, J.M.; Collins, S.L.; Hartnett, DC; Johnson, L.C.; Towne, E.G. 1999. The keystone role of bison in North American tall-grass prairie. BioScience: 49(1):39–50.

Knick, S.T.; Rotenberry, J.T. 1995. Landscape characteristics of fragmented shrubsteppe landscapes and breeding passerine birds. Conservation Biology 9:1059–1071.

Knopf, F.L.; R.W. Cannon. 1982. Structural resilience of a willow riparian community to changes in grazing practices. In: Wildlife-livestock relationships symposium: proceedings 10. Moscow, ID: University of Idaho Forest, Wildlife, and Range Experiment Station. 198–207.

Knopf, F.L. 1985. Significance of riparian vegetation to breeding birds across an altitudinal cline. In: Johnson, R.R.; Ziebell, C.D.; Patten, D.R.; Folliot, P.F.; Hamre, R.H.; tech coords. Riparian ecosystems and their management: reconciling conflicting uses. Forest Service General Technical Report RM-120. [Place of publication unknown]: U.S. Department of Agriculture. 105–111.

Knopf, F.L.; Johnson, R.R.; Rish, T.; Samson, F.B.; Szaro, R.C. 1988. Conservation of riparian ecosystems in the United States. Wilson Bulletin 100:272–284.

Krizansky, Lauren. 2013. Valley Courier. New transmission route proposed. January 15. [Internet] <http://www.alamosanews.com/v2_news_articles.php?heading=0&story_id=28051&page=72> accessed January 14, 2014.

Krueper, D.J. 1993. Effects of land use practices on western riparian ecosystems. In: Finch, D.M.; Stangel, P.W., eds. Status and management of neotropical migratory birds. General Technical Report RM–229. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. 422 p. 321–330.

Lambeck, R. 1997. Priority species: a multi–species umbrella for nature conservation. Conservation Biology 11:849–856.

Lanyon, W.E. 1962. Species limits and distribution of meadowlarks of the desert grassland. Auk 79:183–207.

Larson, L.R.; Decker, D.J.; Stedman, R.C.; Siemer, W.F.; Baumer, M.S.; Enck, J.W. 2013. Hunter recruitment and retention in New York: a framework for research and action. Human Dimensions Research Unit Series Publication 13-04. Ithaca, N.Y.: Cornell University, Department of Natural Resources. 72 p.

Laubhan, M.K.; King, S.L.; Fredrickson, L.H. 2012. Managing inland wetlands for wildlife. Silvy, N.J., ed. In: P. 198–207. The wildlife techniques manual, volume 2. 7th edition. Baltimore, MD: The John Hopkins University Press.

Leonard, M.K.; Watts, K.R. 1989. Hydrogeology and similated effects of ground-water development on an unconfined acquifer in the Closed Basin Division, San Luis Valley, Colorado. Denver, CO: U.S. Geological Survey, Water Resources Investigations Report 87–4284. 47p.

Levings, G.; D. F. Healy; S. F. Richey; L. F. Carter. 1998. Water quality in the Rio Grande Valley, Colorado, New Mexico, and Texas: 1992–1995. [Internet]. U.S. Geological Survey Circular 1162. 44 p. <http://pubs.usgs.gov/circ/circ1162/circ1162.pdf> [Access date unknown]

Ligon, J.S. 1961. New Mexico birds and where to find them. The University of New Mexico Press, Albuquerque, NM. 360 p.

Lopez-Tushar, O. 1997. The people of El Valle: a history of the Spanish colonials in the San Luis Valley. Pueblo, CO: El Escritorio.

Louv, R. 2005. Last child in the woods: saving our children from nature deficit disorder. Chapel Hill, NC: Aloquin. 323 p.

Machette, M.N.; Marchetti, D.W.; Thompson, R.A. 2007. Ancient Lake Alamosa and the Pliocene to middle Pleistocene evolution of the Rio Grande. Rocky Mountain Section, Friends of the Pleistocene Field Trip. Quaternary geology of the San Luis basin of Colorado and New Mexico: preliminary geologic map of the north-central part of the Alamosa 30 x 60 quadrangle, Alamosa, Conejos and Costilla counties, Colorado.

Mackelprang, C.E. 1983. Results of a detailed gravity survey in the Alamosa area, Alamosa County, Colorado. [Place of publication unknown]: Earth Science Laboratory, University of Utah Research Institute.

Madole, R.F.; Romig, J.N.; Aleinikoff, J.N.; VanSistine, D.P.; Yacob, E.Y. 2008. On the origin and age of the Great Sand Dunes, Colorado. Geomorphology 99:99–119.

Martorano, M. 1999a. Post paleoindian paleoenvironmental studies. In: Martorano, M.A.; Hoefer III, T.; Jodry, M.A.; Spero, V.; Taylor, M.L. Colorado prehistory: a context for the Rio Grande basin. [Golden, CO: Colorado Council of Professional Archaeologists. 27–30.

———. 1999b. Late prehistoric/ceramic stage. In: Martorano, M.A.; Hoefer III, T.; Jodry, M.A.; Spero, V.; Taylor, M.L. Colorado prehistory: a context for the Rio Grande basin. [Golden, CO: Colorado Council of Professional Archaeologists. 129–137.

———. 1999c. Late protohistoric stage. Martorano, M.A.; Hoefer III, T.; Jodry, M.A.; Spero, V.; Taylor, M.L. Colorado prehistory: a context for the Rio Grande basin. [Golden, CO: Colorado Council of Professional Archaeologists. 138–145.

Marshall, R.M.; Stoleson, S.H. 2000. In: Finch, D.M.; Stoelson, S.H., eds. Status, ecology, and conservation of the southwestern willow flycatcher. General Technical Report-60. [Place of publication unknown]. U.S. Forest Service, Rocky Mountain Research Station. 13–24.

Mayo, A.L.; Davey, A.; Christieansen, D. 2006. Groundwater flow patterns in the San Luis Valley, Colorado, USA revisisted: an evaluation of solute and isotope date. [Place of publication unknown]: [Publisher name unknown].

McAdoo, J.K.; Longland, W.S.; Evans, R.A. 1989. Nongame bird community responses to sagebrush invasion of crested wheatgrass seedings. Journal of Wildlife Management 53:494–502.

McArthur, E.D.; Taylor, J.R. 2004. Chrysothamnus nauseosus *(Pallas ex Pursh)* Britton, Asteraceae. In: J.K. Francis, ed. Wildland shrubs of the United States and its territories: thamnic descriptions—volume 1. General Technical Report IITF-GTR-26. Fort Collins, CO: USDA Forest Service.

McCalpin, J.P. 1996. General geology of the northern San Luis Valley, Colorado. In: Geologic excursions to the Rocky Mountains and beyond. Colorado Geological Survey, Denver, CO. 11p. [Internet] <http://www.nps.gov/grsa/naturescience/upload/Trip2021.pdf> accessed November 21, 2013.

Meaney, C.A.; Van Vuren, D. 1993. Recent distribution of bison in Colorado west of the Great Plains. Proceedings of the Denver Museum of Natural History. Series 3, Number 4. [Place of publication unknown]. 10 p.

Meehan, W.R.; Swanson, F.J.; Sedell, J.R. 1977. Influences of riparian vegetation on aquatic ecosystems with particular reference to salmonid fishes and their food supply. In: Johnson, R.R.; Jones, D.A. eds. Importance, preservation, and management of riparian habitat: a symposium. Forest Service General Technical Report RM-43. [Place of publication unknown]: U.S. Department of Agriculture, Forest Service. 137–43.

Meretsky, V.J.; Fishman, R.L.; Karr, J.R.; Ashe, D.M.; Scott, J.M.; Noss, R.F.; Schroeder, R.L. 2006. New directions in conservation for the National Wildlife Refuge System. Bioscience 56:135–143.

[MBCC]Migratory Bird Conservation Commission. 1952. Approval for purchase of three tracts in the Monte Vista National Wildlife Refuge. On file in Region 6, Planning Division, Lakewood, CO. 1 p.

———. 1962. Approval letter for establishment of Alamosa National Wildlife Refuge and addition to the Monte Vista National Wildlife Refuge. On file in Region 6, Planning Division, Lakewood, CO. 1 p.

Miller, J.R.; Hobbs, N.T. 2000. Recreational trails, human activity, and nest predation in lowland riparian areas. Landscape and Urban Planning 50:227–236.

Miller, S.G.; Knight, R.L.; Miller, C.K. 1998. Influence of recreational trails on breeding bird communities. Ecological Applications 8:162–169.

Mitsch, W.J.; Gosselink, J.G. 2003. Wetlands. 2nd edition. New York, NY: Van Nostrand Reinhold. 722 p.

Montgomery, D.R.; Abbe, T.B.; Buffington, J.M.; Peterson, N.P.; Schmidt, K.M.; Stock, J.D. 1996. Distribution of bedrock and alluvial channels in forested mountain drainage basins. Nature 381:587–589.

Mosconi, S.L.; Hutto, R.L. 1982. The effects of grazing on land birds of a western Montana riparian habitat. In: Wildlife-livestock relationships symposium: Proceedings 10. Moscow, ID: University of Idaho Forest, Wildlife, and Range Experiment Station. 221–233.

Murphy, R.K. 2009. Baca National Wildlife Refuge technical assistance report. Kearney, NE: University of Nebraska, Kearney. 38 p.

National Fish, Wildlife and Plants Climate Adaptation Partnership; Association of Fish and Wildlife Agencies; Council on Environmental Quality; Great Lakes Indian Fish and Wildlife Commission; National Oceanic and Atmospheric Administration; U.S. Fish and Wildlife Service. 2012. National fish, wildlife and plants climate adaptation strategy. Washington, DC. 20 p.

National Park Traveler. 2012. Early Latino settlement in Colorado designated National Historic Landmark. 2012. <http://www.nationalparkstraveler.com/2012/01/early-latino-settlement-colorado-designated-national-historic-landmark9248> accessed November 20, 2013.

National Research Council. 2002. Riparian areas: functions and strategies for management. Committee on Riparian Zone Functioning and Strategies for Management, Water Science and Technology Board. Washington, DC: National Academy Press. 444 p.

Natural Resources Committee. February 1938. Regional Planning, Part VI - The Rio Grande joint investigation in the Upper Rio Grande Basin in Colorado, New Mexico, and Texas 1936–1937. Washington, DC: U.S. Government Printing Office, 566p. <http://www.archive.org/stream/regionalplanning1938riogranderich#page/564/mode/2up> accessed September 12, 2013.

Neckles, H.A.; Murkin, H.R.; Cooper, J.A. 1990. Influence of seasonal flooding on macroinvertebrate abundance in wetland habitats. Freshwater Biology 23:311–322.

The New York Times. 1898. Up the Rio Grande in 1821: Jacob Fowler's quaint and interesting journal of the trip. June 18, 1898. [[Section and column unknown].

North American Bird Conservation Initiative. 2013. Bird Conservation Regions. [Internet] <http://www.nabci-us.org/bcrs.htm> Accessed December 16, 2013.

Ohmart, R.D. 1994. The effects of human-induced changes on the avifauna of western riparian habitats. Studies in Avian Biology 15:273–285.

Olson, D.; Lindall, S. 1999. IMPLAN professional software, analysis and data guide. [Place of publication unknown]: Minnesota IMPLAN Group, Inc.

Owen, J.C.; Sogge, M.K. 1997. Banding and genetic sampling of willow flycatchers in Colorado: 1996 and 1997 summary report. October 1997. Flagstaff, AZ: USGS Colorado Plateau Field Station at Northern Arizona University.

Page, G.W.; Gill, R.E. 1994. Shorebirds in western North America: late 1800s to late 1900s. Studies in Avian Biology 15:147–160.

Page, G.W.; Stenzel, L.E.; Page, G.W.; Warriner, J.S.; Warriner, J.C.; Paton, P.W. 2009. Snowy plover *(Charadrius nivosus)*. In: Poole, A., ed. The birds of North America online. Cornell Lab of Ornithology, Ithaca, New York. <http://bna.birds.cornell.edu/bna/species/154> accessed 16 May 2013.

Painter, T.H.; Deems J.S.; Belnap, J.; Hamlet, A.F.; Landry, C.C.; Udall, B. 2010. Response of Colorado River runoff to dust radiative forcing in snow. Proceedings of the National Academy of Science107:17125–17130.

Partners in Flight. 2010. What is Partners in Flight (PIF)? [Internet] <www.partnersinflight.org/description.cfm> accessed December 2011.

Pase, C.P.; Layser, E.F. 1977. Classification of riparian habitat in the southwest. In: Johnson, R.R.; Jones Jr., D.A., tech. coords. Importance, preservation and management of riparian habitat: a symposium. General Technical Report RM-43. [Place of publication unknown]: U.S. Department of Agriculture, Forest Service. 5–9.

Patton, D.R. 1977. Riparian research needs. In: Johnson, R.R.; Jones Jr., D.A., tech. coords. Importance, preservation and management of riparian habitat: a symposium. General Technical Report RM-43. [Place of publication unknown]: U.S. Department of Agriculture, Forest Service. 80–82.

Paxton, E.H. 2000. Molecular genetic structuring and demographic history of the willow flycatcher *(Empidonaz trailii)* [master's thesis]. Flagstaff, AZ: Northern Arizona University. [46 p.

Peinetti, J.R.; Menezes, R.S.C.; Coughenour, M.B. 2001. Changes induced by elk browsing in the aboveground biomass production and distribution of willow *(Salix monticola Bebb)*: their relationships with plant water, carbon, and nitrogen dynamics. Oecologia 127:334–342.

Pilliod, D.S.; Wind, E., eds. 2008. Habitat management guidelines for amphibians and reptiles of the northwestern United States and western Canada. Technical Publication HMG-4. Birmingham, AL.: Partners in Amphibian and Reptile

Poole, Linda D. Reproductive success and nesting habitat of loggerhead shrikes in shrubsteppe communities [master's thesis]. [Place of publication unknown]: Oregon State University, 1992. [Internet] <http://scholarsarchive.library.oregonstate.edu/xmlui/bitstream/handle/1957/21947/PooleLindaD1992.pdf?sequence=1> Accessed May 16, 2013.

Powell, W. J.; Mutz, P. (1958). Ground-water resources of the San Luis Valley, Colorado. USGS Water Supply Paper 1379. U.S. Geological Survey. [Place of publication unknown]. U.S. Government Printing Office.

Preuss, Charles. 1958. Exploring with Fremont. Gudde, E.G., Gudde, E.K. eds. Norman, OK: University of Oklahoma Press.

Ranchlands. 2013. Medano Zapata Ranch information [Internet]. <http://www.ranchlands.com/index.cfm?id=4472BC80-F8B9-4966-B073F54A46F67868>. Accessed January 9, 2014.

Ray, A.J.; Barsugli, J.J.; Averyt, K.B.; Wolter, K.; Hoerling, M.; Doesken, N.; Udall, B.; Webb, R.S. 2008. Climate change in Colorado: a synthesis to support water resources management and adaptation. Western Water Assessment for the Colorado Water Conservation Board. 58p. <http://wwa.colorado.edu/publications/reports/WWA_ClimateChangeColoradoReport_2008.pdf> accessed Sept. 2013.

Reeves, C.C., Jr.; Temple, J.M. 1986. Permian salt dissolution, alkaline lake basins, and nuclear waste storage, southern high plains, Texas and New Mexico. Geology 14:939–942.

Reed, Alan D. 1994. The Numic occupation of western Colorado and eastern Utah during the prehistoric and protohistoric periods. In: Madsen, D.B.; Rhode, D. Across the West: Human population movement and the expansion of the Numa. Salt Lake City: University of Utah Press. 188–199.

Rees, D.E; Carr, R.J.; Miller, W.J. 2005a. Rio Grande chub *(Gila pandora)*: a technical conservation assessment. [Internet]. USDA Forest Service, Rocky Mountain Region. <http://www.fs.fed.us/r2/projects/scp/assessments/riograndechub.pdf> accessed August 11, 2013.

———. 2005b. Rio Grande sucker *(Catostomus plebeius)*: a technical conservation assessment. [Internet]. USDA Forest Service, Rocky Mountain Region. <http://www.fs.fed.us/r2/projects/scp/assessments/riograndesucker.pdf> accessed August 11, 2013.

Reijnen, R.; Foppen, R. 1994. The effects of car traffic on breeding bird populations in woodland. I. Evidence of reduced habitat quality for willow warbler *(Pylloscopus trochilus)* breeding close to a highway. Journal of Applied Ecology 31:85–94.

Renaud, E.B. 1942. Reconnaissance work in the upper Rio Grande Valley: Colorado and New Mexico. Department of Anthropology Archaeological Series: Third Paper, University of Denver.

Richmond, Patricia Joy. 1990. Trail to disaster. Colorado Historical Society, Denver.

Riffell, S.K.; Gutzwiller, K.J.; Anderson, S.H. 1996. Does repeated human intrusion cause cumulative declines in avian richness and abundance? Ecological Applications 6:492–505.

Riley, C.D. 2001. Population dynamics and ecological characteristics of Cleome multicaulis, a rare annual wetland halophyte of the San Luis Valley, Colorado [Ph.D. dissertation]. Fort Collins, CO: Colorado State University.

Rio Grande County. 2004. Joint master plan: Del Norte, Monte Vista, Rio Grande. [Place of publication unknown]: [Publisher unknown].

Rio Grande Water Conservation District. 2012. Rio Grande Water Conservation District: Subdistrict #1. <http://www.rgwcd.org/page9.html> [access date unknown].

———. 2012. San Luis Valley regional habitat conservation plan. November, 2012. 197p. <http://www.slvhcp.com/Web_Docs/Final20SLV20HCP20-20Nov202012.pdf> accessed November 20, 2013.

———. 2013. Projects page. [Internet] <http://www.rgwcd.org/page9.html> accessed February 4, 2013.

———. 2014. Home page. [Internet] <http://www.rgwcd.org> accessed January 21, 2014.

Ripple, W.J.; Beschta, R.L. 2004a. Wolves and the ecology of fear: can predation risk structure ecosystems? BioScience 54:755–766.

Ripple, W.J.; Beschta, R.L. 2004b. Wolves, elk, willows, and trophic cascades in the upper Gallatin Range of southwestern Montana. Forest Ecology and Management 200:161–181.

Robbins, C.S.; Bystrak, D.; Geissler, P.H. 1986. The breeding bird survey: its first fifteen years—1965–1979. Resource Publication 157. [Place of publication unknown]: U.S. Fish and Wildlife Service. 196 p.

Robson, S.; Banta, E. 1995. Ground water atlas of the United States: Arizona, Colorado, New Mexico, Utah—Rio Grande aquifer system. U.S. Geological Survey.

Rocchio, J.; Culver, D.; Kettler, S.; Schoor, R. 2000. Biological inventory of Rio Grande and Conejos Counties, Colorado. Volume 2: A natural heritage inventory and assessment of wetlands and riparian areas in Rio Grande and Conejos Counties.

Rogers, K.L.; Larson, E.E.; Smith, G.; Katzman, D.; Smith, G.R.; Cerling, T.; Wang, Y.; R.G. Baker, R.G; Lohmann, K.C.; Repenning, C.A.; Patterson, P.; Mackie, G. 1992. Pliocene and pleistocene geologic and climatic evolution in the San Luis Valley of south-central Colorado. Palaeogeography, Palaeoclimatology, Palaeoecology 94:55–86.

Rosenberg, K.V.; Ohmart, R.D.; Hunter, W.C.; Anderson, B.W. 1991. Birds of the lower Colorado River valley. Tucson, AZ: University of Arizona Press. 416 p.

Rotenberry, J.T.; Wiens, J.A. 1980. Habitat structure, patchiness, and avian communities in North American steppe vegetation: a multivariate analysis. Ecology 61:1228–1250.

Ryder, R.A. 1980. Effects of grazing on bird habitats. DeGraff, R.M.; Tilghman, N.G., compilers. In: Management of western forests and grasslands for nongame birds. General Technical Report INT-86. [Place of publication unknown]: U.S. Department of Agriculture. 51–66.

Safina, C.; Burger, J. 1983. Effects of human disturbance on reproductive success in the black skimmer. Condor 85:164–171.

Saguache County. 2011. Crestone Baca comprehensive plan background issues report. May 9, 2011. 8p. <http://www.saguachecounty.net/images/stories/Background_Report_1.pdf> accessed November 20, 2013.

Sanchez, B.C.; Archuleta, L.C.; Sepulveda, M.S. 2012. The presence of pharmaceuticals, personal care products, and other wastewater chemicals on the Baca National Wildlife Refuge and their effect on two species of imperiled fish. Colorado Ecological Services Field Office. Lakewood, CO: USFWS

Environmental Contaminants Program - On-refuge investigations sub-activity.

Sanchez, J.P. 1997. Explorers, traders, and slavers: forging the Old Spanish Trail, 1678–1850. Salt Lake City, UT: University of Utah Press.

Sanderson, E.W.; Redford, K.H; Weber, B.; Aune, K.; Baldes, D.; Berger, J.; Carter, D.; Curtin, C.; Derr, J.; Dobrott, S.; Fearn, E.; Fleener, C.; Forrest, S.; Gerlach, C.; Cormack Gates, C.; Gross, J.E.; Gogan, P.; Grassel, S.; Hilty, J.A.; Jensen, M.; Kunkel, K.; Lammers, D.; List, R.; Minkowski, K.; Olson, T.; Pague, C.; Robertson, P.B.; Stephenson, B. 2008. The ecological future of the North American bison: conceiving long-term, large-scale conservation of wildlife. Conservation Biology 22(2):252–266.

San Luis Valley Water Conservancy District. 2001. Rio Grande headwaters restoration project technical advisory committee, Colorado Water Conservation Board. Rio Grande Headwaters Restoration Project. Unpublished report.

Sauer, J.R.; Hines, J.E.; Fallon, J. 2004. The North American breeding bird survey: results and analysis, 1966–2002. Version 2003.1. Laurel, MD: U.S. Department of Interior, Geological Survey, Patuxent Wildlife Research Center.

Sauer, J.R.; Hines, J.E.; Gough, G.; Thomas, I.; Peterjohn, B.J. 1997. The North American breeding bird Survey: results and analysis, 1966–2002. Version 93.6. Laurel, MD: U.S. Department of Interior, Geological Survey, Patuxent Wildlife Research Center.

Sauer, J.R.; Hines, J.E.; Fallon, J.E.; Pardieck, K.L.; Ziolkowski, E.J., Jr.; Link, W.A. 2012. The North American breeding bird survey: results and analysis, 1966–2011. Version 07.03.2013. USGS Patuxent Wildlife Research

Scott, M.L.; Shafroth, P.B.; Auble, G.T. 1999. Responses of riparian cottonwoods to alluvial water table declines. Environmental Management 23:347–358.

Scott, M.L.; Skagen, S.K.; Merigliano, M.F. 2003. Relating geomorphic change and grazing to avian communities in riparian forests. Conservation Biology 17:284–296.

Shafroth, P.B.; Stromberg, J.C.; Patten, D.T. 2000. Woody riparian vegetation response to different alluvial water table regimes. Western North American Naturalist 60(1):66–76.

Siebenthal, C. (1910). Geology and water resources of the San Luis Valley, Colorado. Water Supply Paper 240. Washington, DC: US Geological Survey.

Simmons, Virginia McConnell. 1999. The San Luis Valley: land of the six-armed cross. 2nd edition. Boulder, CO: University Press of Colorado. 364 p.

Singer, F.J.; Mack, L.; Cates, R.G. 1994. Ungulate herbivory of willows on Yellowstone's northern winter range. Journal of Range Management 47:435–443.

Skagen, S.K.; Hazelwood, R.; Scott, M.L. 2005. The importance and future condition of western riparian ecosystems as migratory bird habitat. General Technical Report PSW-GTR-191. [Place of publication unknown]: U.S. Department of Agriculture, Forest Service.

Skagen, S.K.; Knight, R.L.; Orians, G.H. 1991. Human disturbance of an avian scavenging guild. Ecological Applications 1:215–225.

Skagen, S.K.; Melcher, C.P.; Howe, W.H.; Knopf, F.L. 1998. Comparative use of riparian corridors and oases by migrating birds in southeast Arizona. Conservation Biology 12:896–909.

Sogge, M.K.; Ahlers, D.; Sferra, S.J. 2010. A natural history summary and survey protocol for the southwestern willow flycatcher: U.S. Geological Survey Techniques and Methods 2A-10. 38 p.

Sogge, M.K.; Marshall, R.M.; Tibbitts, T.J.; Sferra, S.J. 1997. A southwestern willow flycatcher natural history summary and survey protocol. Technical Report NPS/NAUCPRS/NRTR-97/12. [Place of publication unknown]. National Park Service. 37 p.

Sogge, M.K.; Sferra, S.J.; McCarthey, T.D.; Williams, S.O.; Kus, B.E. 2003. Distribution and characteristics of southwestern willow flycatcher breeding sites and territories. Studies in Avian Biology 26:5–11.

Spackman, S.C.; Hughes, J.W. 1995. Assessment of minimum stream corridor width for biological conservation: species richness and distribution along mid-order streams in Vermont, USA. Biological Conservation 71:325–332.

Spencer, F.C. 1975. The story of the San Luis Valley. Alamosa, CO: San Luis Valley Historical Society. 83 p.

Sprunt, A. 1975. Habitat management implications during migration. In: Proceedings of the symposium on management of forest and range habitats for nongame birds. May 6–9, Tucson, AZ. General Technical Report WO-1. [Place of publication unknown]. USDA Forest Service. 81–86.

Stauffer, D.F.; Best, L.B. 1980. Habitat selection by birds of riparian communities: evaluating effects of habitat alterations. Journal of Wildlife Management 44:1–15.

Stephens, S.L.; Moghaddas, J.J.; Edminster, C; Fiedler, C.E.; Haase, S.; Harrington, M.; Keeley, J.E.; Knapp, E.E.; Mclver, J.D.; Ketlen, M.; Skinner, C.N.; Youngblood, A. 2009. Fire treatment effects on vegetation structure, fuels and potential fire severity in western U.S. forests. Ecological

Applications. Vol. 19. No.2 (March 2009). p. 305-320.

Stevens, L.E.; Brown, B.T.; Simpson, J.M.; Johnson, R.R. 1977. The importance of riparian habitat to migrating birds. In: Johnson, R.R.; Jones Jr., D.A., tech. coords. Importance, preservation and management of riparian habitat: a symposium. General Technical Report RM-43. [Place of publication unknown]. U.S. Department of Agriculture, Forest Service. 156–164.

Stewart, R.E. 1975. Breeding birds of North Dakota. Fargo, ND: Tri-College Center for Environmental Studies. 295 p.

Striffler, P.S. 2012. Water resource inventory and assessment (WRIA): Monte Vista National Wildlife Refuge. Lakewood, CO: U.S. Fish and Wildlife Service, Region 6, Division of Water Resources.

Stynes, D. (1998). Guidelines for measuring visitor spending. East Lansing, MI: Michigan State University, Department of Parks, Recreation and Tourism Resources.

Subcommittee on Rocky Mountain Greater Sandhill Cranes. 2007. Management plan of the Pacific and central flyways for the Rocky Mountain population of greater sandhill cranes. Portland, Oregon:[Joint] Subcommittees: Rocky Mountain Greater Sandhill Cranes; Pacific Flyway Study Committee; Central Flyway Webless Migratory Game Bird Technical committee. 90p.

Sullivan, S.M.P.; Watzin, M.C.; Hession, W.C. 2004. Understanding stream geomorphic state in relation to ecological integrity: evidence using habitat assessments and macroinvertebrates. Environmental Management 34(5):669–683.

Szaro, R.C. 1980. Factors influencing bird populations in southwestern riparian forests. In: DeGraff, R.M., tech. coord. Management of western forests and grasslands for nongame birds. General Technical Report INT-86. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 403–418.

Szaro, R.C.; Jakle, M.D. 1985. Avian use of a desert riparian island and its adjacent scrub habitat. Condor 87:511–519.

Tacha, T.C.; Vohs, P.A.; Iverson, G.C. 1987. Time and energy budgets of sandhill cranes from mid-continental North America. Journal of Wildlife Management 51:440–448.

Taylor, D.M. 1986. Effects of cattle grazing on passerine birds nesting in riparian habitat. Journal of Range Management 39:254–258.

Thomas, H.E. 1963. Effects of drought in the Rio Grande basin. U.S. Geological Survey Professional Paper 372-D. [Place of publication unknown.]

Thomas, J.W.; Maser, C.; Rodiek, J.E. 1979. Wildlife habitats in managed rangelands: the Great Basin of southeastern Oregon—riparian zones. General Technical Report PNW-80. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 18p.

Tredennick, Cam. 2000. The National Wildlife System Improvement Act of 1997: defining the National Wildlife Refuge System for the twenty-first century. 12 Fordham Environmental Law Journal 1:41–109.

Turina, F. 2010. Case study: protecting the acoustic conditions at Great Sand Dunes National Park and Preserve. [Internet]. Park Science 26(3):52. <http://www.nature.nps.gov/ParkScience/index.cfm?ArticleID=379> accessed 26 November 26, 2013.

U.S. Air Force. 2011. Environmental assessment for the establishment of low altitude training for Cannon AFB, New Mexico. August 2011. <http://www.cannon.af.mil/shared/media/document/AFD-110909-039.pdf> accessed November 2013.

U.S. Army Corps of Engineers. January 1878. Land classification map of part of southwestern Colorado. Atlas sheet number 61(D). U.S. Army Corps of Engineers, Issued January 1878.

[USDA] U.S. Department of Agriculture; Rural Utilities Service. 2009. San Luis Valley-Calumet-Comanche transmission project. Final scoping report. November 2009. [Internet] <http://www.rurdev.usda.gov/SupportDocuments/Tri-State20SLVCC20Scoping20Report20111609.pdf> accessed January 14, 2014.

[USDA] U.S. Department of Agriculture, Forest Service; [DOI] U.S. Department of Interior, [NPS] National Park Service. 2009. Environmental assessment for comment: Baca Mountain tract and Camino Chasima project. June 2009. 198p.

[USDA] U.S. Department of Agriculture. 2007a. Census of agriculture—state profile for Colorado: 2007 Census Publications. [Internet]. <http://www.nass.usda.gov/Statistics_by_State/Colorado/Agriculture_Profile/Profile20A ug202013.pdf.> accessed September 30, 2013.

———.2007b. Census of Agriculture—state profile for Colorado counties: 2007 census publications [Internet] <http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/County_Profiles/Colorado/index.asp> accessed September 30, 2013.

[USDA] U.S. Department of Agriculture; Colorado Department of Agriculture. 2007. Census of agriculture state profile for Colorado: 2007 Census Publications. National Agricultural Statistics Service. [Internet]. <http://www.nass.usda.gov/Statistics_by_State/Colorado/Agriculture_Profile/

Profile20Aug202013.pdf> accessed September 30, 2013. 2 p.

[USDA], Forest Service. 2012. Village at Wolf Creek access project: draft environmental impact statement. Rio Grande National Forest. August. [Internet] <http://www.fs.fed.us/nepa/fs-usda-pop.php/?project=35945> Accessed January 14, 2014

[USDA], Soil Conservation Service. 1973. Soil survey of Alamosa County, Colorado. In cooperation with Colorado Agricultural Experiment Station. [Place of publication unknown].

———. 1980. Soil survey of Rio Grande County Area, CO. In cooperation with Colorado Agricultural Experiment Station. [Place of publication unknown].

———. 1981. Soil survey of Saguache County Area, CO. In cooperation with Colorado Agricultural Experiment Station. [Place of publication unknown].

[U.S. Department of Commerce] Bureau of Economic Analysis 2012. Local area personal income: table CA25N NAICS (2001–2010), total employment by industry. [Internet]. <http://www.bea.gov/regional/reis/> accessed Oct 22, 2013.

[U.S. Department of Commerce] Census Bureau. 2010. State and county QuickFacts. [Internet].<http://quickfacts.census.gov/qfd/index.html> accessed September 27, 2013

———. 2000. Profile of general demographic characteristics, 2000: American FactFinder. [Internet]. <http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_ 00_SF1_DP1&prodType=table> accessed September 27, 2013.

———. 2010. 2005–2009 American community survey employment status 5-year estimates: American FactFinder. [Internet]. <http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_ 09_5YR_S2301&prodType=table> accessed September 27, 2013

———. 2011. 2007–2011 American community survey demographic and housing 5-year estimates: American FactFinder. [Internet]. <http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_5YR_DP05&prodType=table> accessed September 27, 2013.

———. 2011. 2007–2011 American community survey employment status 5-year estimates: American FactFinder. [Internet]. <http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_5YR_S2301&prodType=table> accessed September 27, 2013.

———. 2011. 2007–2011 American community survey industry by sex and median earnings in the past 12 months for the civilian employed population 16 years and over 5-year estimates: American FactFinder. [Internet]. <http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_5YR_S2403&prodType=table> accessed September 27, 2013.

———.2012. State and County QuickFacts – Colorado. <http://quickfacts.census.gov/qfd/states/08000.html> accessed September 3, 2013.

U.S. Department of Energy. 1999. Office of Fossil Energy and Office of Science report. Carbon sequestration research and development. [Internet]. <www.fossil.energy.gov/programs/sequestration/publications/1999_rdreport> [access date unknown].

[EPA] U.S. Environmental Protection Agency. 1998. Memorandum on interim air quality policy on wildland and prescribed fires. [Internet]. <http://www.epa.gov/ttn/caaa/t1/memoranda/wilson.pdf.> accessed November 21, 2013.

———. 1999. Consideration of cumulative impacts in EPA review of NEPA documents. U.S.Environmental Protection Agency, Office of Federal Activities (2252A). EPA 315-R-99-002. May 1999. 22p. <http://www.epa.gov/compliance/resources/policies/nepa/cumulative.pdf> accessed April 2, 2014.

———. 2008. Ecological toxicity information. [Internet] <epa.gov/R5Super/ecology> [access date unknown].

———.2012a. EPA RAD interface [Internet]. Retrieved March 06, 2012, from Enforcement & Compliance History Online (ECHO): <http://epamap32.epa.gov/radims/>

———. 2012b. Air quality index report, Alamosa County for 2012. <http://www.epa.gov/airdata> accessed July 2013.

[DOI] U.S. Department of the Interior. 2001. Secretarial Order 3226. Evaluating climate change impacts in management planning. 1 p.

———. 2008. Bison conservation initiative. [Internet]. <www.doi.gov/initiatives/bison/Bison20Bridge20Page20DOI20Bison20Conservation20Initiative20framework.pdf> accessed November 21, 2013.

———. 2009. Secretarial Order 3289. Addressing the impacts of climate change on America's water, land, and other natural and cultural resources. [Internet]. <www.doi.gov/climatechange/SecOrder3289.pdf> accessed September 22, 2009. 4 p.

[DOI] BLM] Bureau of Land Management. 1991. Draft San Luis resource management plan and environmental impact statement. Canon City, CO: U.S. Department of the Interior.

———. 2010. South San Luis Lakes wetland restoration project: decision record and finding of no significant impact. DOI-BLM-CO-140-2010-009-EA. March. San Luis Valley Resource Area. [Internet]. <http://www.blm.gov/pgdata/etc/medialib/blm/co/field_offices/slvplc/Upload_Files.Par.67229.File.dat/SSL_Final_FONSI_red.pdf> accessed November 20, 2013.

———. 2012a. Approved resource management plan amendments/record of decision (ROD) for solar energy development in six southwestern states. October 2012. [Internet]. <http://solareis.anl.gov/documents/docs/Solar_PEIS_ROD.pdf> accessed January 14, 2013. 197 p.

———. 2012b. BLM seeks comments on preliminary oil and gas drilling analysis (06-18-13). [Internet]. <http://www.blm.gov/co/st/en/BLM_Information/newsroom/2013/blm_seeks_comments0.html> accessed November 20, 2013.

———. 2013. Blanca wetlands ACEC enlargement and grazing plan. [Internet]. <http://www.blm.gov/pgdata/etc/medialib/blm/co/information/nepa/san_luis_valley_public/blanca.Par.69295.File.dat/BlancaProjectSummaryDraftEA.5.2013.pdf> accessed November 20, 2013.

[DOI] [BOR] Bureau of Reclamation. 2013a. The San Luis Valley project. <http://www.usbr.gov/history/sanluisv.html> accessed November 2013. 10 p.

———. 2013b. West-wide climate risk assessment: upper Rio Grande Impact Assessment. <http://www.usbr.gov/WaterSMART/wcra/reports/urgia.html> accessed December 16, 2013. 169p.

[DOI] U.S. Department of the Interior, [FWS] Fish and Wildlife Service; SEMARNAP Mexico; and Environment Canada. 1998. North American waterfowl management plan. <www.fws.gov/birdhabitat/NAWMP/files/NAWMP1998.pdf> accessed December 2011. 43 p.

[DOI] U.S. Department of the Interior, [FWS] Fish and Wildlife Service; U.S. Department of Commerce, U.S.Census Bureau. 2011. National survey of fishing, hunting, and wildlife-associated recreation. Washington, DC. 143 p.

[DOI] U.S. Department of the Interior, [NPS] National Park Service, [FWS] Fish and Wildlife Service, [TNC] The Nature Conservancy. 2006. Great Sand Dunes National Park and Preserve, San Luis Valley National Wildlife Refuge Complex, and Medano-Zapata Ranch: Colorado Greater Sand Dunes interagency fire management plan. [Place of publication unknown]. 320 p.

[DOI][FWS] U.S. Fish and Wildlife Service. 1962. Master plan for physical and biological development of Monte Vista National Wildlife Refuge. Denver, CO: U.S. Fish and Wildlife Service.

———. 1969. Memo regarding acquisition history of Alamosa National Wildlife Refuge. February 26, 1969. On file in Region 6 Realty Division, Lakewood, CO. 6 p.

———. 1993. Endangered and threatened wildlife and plants: determination of threatened status for the Pacific Coast population of the western snowy plover. Federal Register 58:12864–12874.

———. 1994. Monte Vista National Wildlife Refuge. A report on the acquisition history and participation activities. On file in Region 6 Realty Division, Lakewood, CO. 12 p.

———. 1995. Final rule determining endangered status for the southwestern willow flycatcher. Federal Register 60:10694. February 27, 1995.

———. 1999. Fulfilling the promise: the National Wildlife Refuge System. Arlington, VA. 94 p.

———. 2000a. Compatibility. 603FW2. In: Fish and Wildlife Service Policy Manual. Washington, DC. 12 p.

———. 2000b. Prescribed fire management. 621FW3. In: Fish and Wildlife Service Policy Manual. Washington, DC. 3 p.

———. 2000c. Refuge planning overview. 602FW1. In: Fish and Wildlife Service Policy Manual. Washington, DC. 6 p.

———. 2001. Biological integrity, diversity, and environmental health. 601FW3. In: Fish and Wildlife Service Policy Manual. Washington, DC. 8 p.

———. 2002. Southwestern willow flycatcher recovery plan. Albuquerque, NM. I-ix +210pp., Appendices A–O.

———. 2003. Comprehensive conservation plan: Alamosa-Monte Vista National Wildlife Refuge Complex, Colorado. Washington, DC. [Internet]. <http://www.fws.gov/mountain-prairie/planning/ccp/co/alm_mtv/alm_mtv.html> accessed November 25, 2013. 147p.

———. 2005. Conceptual management plan. Baca National Wildlife Refuge. May 2005. <http://www.fws.gov/alamosa/PDF/archives/baca_cmp_web.pdf> accessed November 2013. 71 p.

———. 2006a. Environmental education. 605FW6. In: Fish and Wildlife Service Policy Manual. Washington, DC. 3 p.

———. 2006b. Hunting. 605FW2. In: Fish and Wildlife Service Policy Manual. Washington, DC. 5 p.

———. 2006c. Interpretation. 605FW7. In: Fish and Wildlife Service Policy Manual. Washington, DC. 3 p.

———. 2006d. Recreational fishing. 605FW3. In: Fish and Wildlife Service Policy Manual. Washington, DC. 6 p.

———. 2006e. Wildlife-dependent recreation. 605FW1. In: Fish and Wildlife Service Policy Manual. Washington, DC. 11 p.

———. 2008. Wilderness stewardship planning. 610FW3. In: Fish and Wildlife Service Policy Manual. Washington, DC. 5 p.

———. 2009. Endangered and threatened wildlife and plants; review of native species that are candidates for listing as endangered or threatened; annual notice of findings on resubmitted petitions; annual description of progress on listing actions; notice of review. Federal Register 74(215):57804–57878.

———. 2010. Rising to the challenge: strategic plan for responding to accelerating climate change. Washington, DC. [Internet]. <www.fws.gov/home/climatechange/pdf/CCStrategicPlan.pdf> accessed April 2011.

———. 2011a. Conserving the future: wildlife refuges and the next generation. Washington, DC. 49 p.

———. 2011b. Environmental assessment of proposed oil and gas exploration, Baca National Wildlife Refuge, Saguache County, Colorado. [Internet]. <http://www.fws.gov/alamosa/baca/Baca_EA_Final_03.31.11.pdf> accessed November 2013. 518p.

———. 2011c. Information quality: ensuring the quality and credibility of information. [Internet]. <www.fws.gov/informationquality/peer_review/index.html> accessed July 2011.

———. 2011d. Managing invasive plants: management methods—grazing. [Internet]. <www.fws.gov/invasives/staffTrainingModule/methods/grazing/introduction.html> accessed July 2011.

———. 2011e. Migratory bird lists. Migratory Bird Program. [Internet]. <www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BirdManagement.html> accessed September 2011.

———. 2011f. National wildlife refuges purposes database. [Internet]. <www.fws.gov/refuges/policiesandbudget /purposes/Purposes_Search.cfm> accessed April 18, 2011.

———. 2011g. Public involvement summary [for the] San Luis Valley National Wildlife Refuge Complex: Alamosa, Monte Vista, and Baca National Wildlife Refuges. [Internet]. <http://www.fws.gov/mountain-prairie/planning/ccp/co/alm_bac_mtv/documents/alm_bac_mtv_ccp_public_summary.pdf> accessed January 2011. 2p.

———. 2011h. Scoping report [for the] San Luis Valley National Wildlife Refuge Complex: Alamosa, Monte Vista, and Baca National Wildlife Refuges. Colorado <http://www.fws.gov/mountain-prairie/planning/ccp/co /alm_bac_mtv/documents/alm_bac_mtv_ccp_scoping.pdf> accessed November 2013. 75p.

———. 2012a. Land protection plan: proposed San Luis Valley Conservation Area. [Internet] <http://www.fws.gov/mountain-prairie/planning/lpp/co/slv/slv.html> accessed January 15, 2014

———. 2012b. Land protection plan: Sangre de Cristo Conservation Area, Colorado and New Mexico. [Internet]. <http://www.fws.gov/mountain-prairie/planning/lpp/co/sdc/documents/sdc_lpp/sdc_lpp_all.pdf> accessed November 2013. 178p.

———. 2012c. Refuge Annual Performing Planning database. [Database is used to report refuge activities.]

———. 2013a. Annual report of lands under control of the U.S. Fish and Wildlife Service as of September 30, 2012. Washington, DC.

———.2013b. Designation of critical habitat for southwestern willow flycatcher. Federal Register 78:2001-0053. January 3, 2013.

———.2013c. Endangered species. [Internet]. <http://www.fws.gov/endangered/> accessed November 25, 2013.

———. 2013d. Endangered and threatened wildlife and plants: 12-month finding on a petition to list the Gunnisons's prairie dog as an endangered or threatened species— notice of 12-month petition. Federal Register 78 (220):68660–68665.

———. 2013e. Final interim elk management plan and environmental assessment for San Luis Valley National Wildlife Refuge Complex. March 2013. On file at Alamosa National Wildlife Refuge headquarters. Alamosa, CO. 79 p.

———. 2013f. Fire management. [Internet]: <http://www.fws.gov/fire> accessed May 2013.

———. 2013g. Gray wolf *(Canis lupus)*. Species profile. [Internet]. <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A00D> accessed November 20, 2013.

———. 2013h. Joint ventures. [Internet]. <www.fws.gov/mountain-prairie/nawm/> accessed November 19, 2013.

———. 2013i. Let's go outside! [Internet]. <http://www.fws.gov/letsgooutside/> accessed November 20, 2013.

———. 2013j. National Wildlife Refuge System. Overview. [Internet]. <http://www.fws.gov/refuges/about/pdfs/OverviewFactSheetApril2013.pdf> accessed November 19, 2013 1 p.

———. 2013k. North American waterfowl management plan. Division of Bird Habitat Consevation. [Internet] <http://www.fws.gov/birdhabitat/NAWMP/index.shtm> accessed November 2013.

———. 2013l. Partners for Fish and Wildlife Program in Colorado. [Internet] <www.fws.gov/mountain-prairie/pfw/Colorado/> accessed October 3, 2011.

———. 2013m. Refuge revenue sharing database. 2012. Washington, DC: Realty Division.

———. 2013n. Wildlife and Sport Fish Restoration Program. [Internet] <http://wsfrprograms.fws.gov/Subpages

/GrantPrograms/SFR/SFR_Accomplishments.htm> accessed April 3, 2014.

———.2014. Comprehensive Conservation Planning and Land Protection Planning for San Luis Valley National Wildlife Refuge Complex. [Internet] <http://www.fws.gov/alamosa/planning/index.html> accessed January 14, 2014.

DOI[USGS] U.S. Geological Survey; [FWS] Fish and Wildlife Service. 2006. Strategic habitat conservation: final report of the national ecological assessment team. [Internet]. Washington, DC <http://www.fws.gov/science/doc/SHC_FinalRpt.pdf> 45p.

[USGS] U.S. Geological Survey. 2010. Dust hastens Colorado River snowmelt, cuts flow. Restoring desert soils could lessen impacts of climate change. News release. October 12. 2010. <http://www.usgs.gov/newsroom/article.asp?ID=2598> accessed November 21, 2013.

———.2011a. National Water Information System, USGS 08220000—Rio Grande near Del Norte, Colorado. [Internet]. <nwis.watrdata.usgs.gov>

———.2011b. National wildlife refuge visitor survey, 2010/2011: Individual refuge results for Monte Vista National Wildlife Refuge. [Place of publication unknown]. 58p.

[NPS] National Park Service. 2007. Great Sand Dunes National Park and Preserve. Final general management plan/wilderness study/environmental impact statement. [Place of publication unknown]. 546 p.

———.2011a. Newsletter 1. Ungulate management plan and environmental impact statement, Great Sand Dunes National Park and Preserve. November. [Internet]. 4 p. <http://parkplanning.nps.gov/document.cfm?documentID=43893> accessed November 20, 2013.

———.2011b. San Luis Valley and Central Sangre de Cristo Mountains: Reconaissance survey report (draft). Denver, CO: Intermountain Regional Office, National Park Service.

———.2012a. NPS annual recreation visits report for: 2007 to 2012. [Internet]. <https://irma.nps.gov/Stats/SSRSReports/System Wide Reports/5 Year annual report by Park?RptYear=2012> accessed September 10, 2013.

———.2012b. Sangre de Cristo National Heritage Area management plan and executive summary. November 2012. 20p. <http://parkplanning.nps.gov/projectHome.cfm?projectID=44518> accessed November 20, 2013.

U.S. Department of Labor, Bureau of Labor Statistics. CPI inflation calculator [Internet]. <http://www.bls.gov/data/inflation_calculator.htm> accessed Nov 1, 2013

———. 2012. Labor force statistics from the current population survey [Internet] <http://www.bls.gov/data/#unemployment> accessed September 27, 2013.

U.S. Department of Transportation, Federal Transit Administration. 2006. Transit noise and impact assessment. FTA-VA-90-1003-06. [Internet]. <http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf> accessed December 30, 2013.

U.S. House of Representatives, 105th Congress, 1st Session. 1997. Report 105–106. National Wildlife Refuge Improvement Act. [Internet]. <www.fws.gov/refuges/realty/archives/pdf/HR_Report_106.pdf> accessed September 2011. 26 p.

Unitt, P. 1987. Empidonax traillii extimus: an endangered subspecies. Western Birds 18(3):137–162.

The Water Information Program. 2012. The Water Information Program: providing water information to the communities of southwest Colorado. [Internet] <http://www.waterinfo.org> accessed March 06, 2012.

Wauer, R.H. 1977. Significance of Rio Grande riparian systems upon the avifauna. Johnson, R.R.; Jones, D.A., eds. In: Importance, preservation, and management of riparian habitat: a symposium. Washington D.C.: U.S. Department of Agriculture, Forest Service. General Technical Report RM-43. 165–174.

Weber, L.M.; Haig, S.M. 1996. Shorebird use of South Carolina managed and natural wetlands. Journal of Wildlife Management 60:73–82.

Weinmeister, Brad. 2010. Sand dunes elk herd data analysis, unit E-11, Game Management Unit 82. Monte Vista, CO: Colorado Division of Wildlife. 16 p.

Western Regional Air Partnership. 2008. Draft white paper: revised 8-hr ozone NAAQS & implications for the western States. [Place of publication unknown.] Prepared by ENIRON International Corporation, July 16, 2008.

Wheeler, G.M. 1877. Land classification map of part of south western Colorado, atlas sheet number 61 (D). U.S. Geographical Survey's West of the 100th Meridian.

Wheeler, G.M.; Humphreys, A.A. 1878. Report upon United States geographical surveys west of the one hundredth meridian. Volume VI: botany. Washington, DC: Government Printing Office.

Wiens, J.A.; Rotenberry, J.T. 1981. Habitat associations and community structure of birds in shrubsteppe environments. Ecological Monographs 51:21–41.

———. 1987. Habitat occupancy patterns of North American shrubsteppe birds: the effect of spatial scale. Oikos 48:132–147.

Williams, G.P.; Wolman, M.G. 1984. Downstream effects of dams on alluvial rivers. U.S. Geological

Survey Professional Paper 1286. Washington, DC: United States Government Printing Office.

Wilson, L.O. 1979. Public forum. In: Cope, O.B., ed. Grazing and riparian/stream ecosystems. Denver, CO: Trout Unlimited, Inc. 77–87.

Willoughby, Scott. 2013. Colorado hunting applications rise in face of boycott, economic strife. Denver Post. June 9, 2013 [Internet] <http://www.denverpost.com/ci_23420712/colorado-hunting-applications-rise-face-boycott-economic-strife> accessed September 16, 2013.

Wyckoff, William. 1999. Creating Colorado: the making of a western American landscape, 1860–1940. New Haven, CT: Yale University Press.

Yong, W.; Finch, D.M. 2002. Stopover ecology of landbirds migrating along the middle Rio Grande in spring and fall. General Technical Report RMRS-GTR-99. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 52 p.

Yosef, R.; Lohrer, F.E. 1995. Shrikes *(Laniidae)* of the world: biology and conservation. Proceedings Western Foundation of Vertebrate Zoology 6:1–343.

Young J.A.; Palmquist, D.E.; Blank, R.S.; Turner, C.E. 1995. Ecology and Control of Pepperweed *(Lepidium latifolium L.)* California Exotic Pest Plant Council. Pages 29-32 In: Proceedings of the California Exotic Pest Plant Council. [Publisher unknown].

Zeigenfuss, L.C.; Singer, F.J.; Williams, S.A.; Johnson, T.L. 2002. Influences of herbivory and water on willow in elk winter range. Journal of Wildlife Management 66:788–795.

Zeisloft, J.; Sibbett, B.S. 1985. User coupled confirmation drilling program case study: city of Alamosa, Colorado—Alamosa #1 geothermal test well. [Place of publication unknown]. Earth Science Laboratory, University of Utah Research Institute, General Technical Report RM-43.

92 Congress, S. 520. 1972. Public Law 92-514. Reclamation Project Authorization Act of 1972.

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